THE CONQUEST OF CULTURE

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How Man Invented His Way to Civilization

By M. D. C. CRAWFORD

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To

E. G. C.

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INTRODUCTION

THIS book was written while the democratic nations still felt the glow of victory over the powers of tyranny, and still believed that by a war we had ended all wars. We mistook for prosperity the feverish efforts of the rearming of our foes preparing for World War II. We speak of these two catastrophes as if there had never been world wars before them.

These were not the first times in history that nations had attempted world dominion and world peace based on a centralized military control. Alexander the Great had successfully conquered the East and the West and might have built an enduring empire if he had not died at the feast of Babylon in the year 323 B.C. The Roman Empire once reached from the Thames to the Euphrates, from the Rhine to the edge of the Sahara. Some fifty thousand miles of hard surfaced roads connected in one pattern of control this vast empire, and commerce, language and law followed the tramp of the marching legions. For two centuries, the Peace of Rome spread over this vast area, and there were attempts to bring this culture into physical contact with the great empire the Hans had built in the valley of the Yellow River area and along the trade centers of Central Asia, the famous roads of silk. Napoleon dreamed of an empire which should cover Europe, conquer Egypt, the Near East and

distant India. The British navy and the Russian snows broke this power. Had he taken full advantage of his technical opportunities, there might have been a different answer. At the time, there was in France a steam land vehicle, which Napoleon saw, but which he regarded as a philosopher's toy. With it, he might have overcome the mud of Waterloo and the drifts of Moscow. He had been shown the mother of mass production and interchangeable part manufacture, later to be adopted by our own Eli Whitney, and Robert Fulton suggested both steamboats to cross the channel and torpedoes to destroy the British navy. Napoleon regarded the first as a sort of picture puzzle, and the other as inventor's nightmares.

Between World War 1 and II, we forced Germany to abandon her archaic arms and turn to her industrial scientists for new weapons so powerful that she almost won the war before we could over match her might.

In this book, I have somewhat hopefully attempted to show man's ingenuity in solving the pressures and perils of his environment. In the matters concerning his material security, he was wise and energetic, often brilliant, but less so in solving the social problems raised by the abundance of his creative thought: for, with each improved tool or process, his social confusion grew; so, he invented war as a recurrent and ineffective solution for these ever increasing social confusions. He invents new and better methods of how to make iron and steel, but instead of better spades, hoes and plows, he has more and sharper swords, spears and bayonets. Instead of a greater harvest of wheat or barley, there are only harvests of dead men. He invents steamboats to make commerce swifter and more certain, but swiftly turns

this new giant to propel war ships. He invents the aeroplane to devour distance, space and time, but turns it into the most dreaded implement of destruction we have come to know.

From Ice to Einstein, every time we invent a new and more useful tool, we change it by some devil's sorcery into newer and more deadly weapons. Men in all times, places and ages have realized that war is the most deadly of all our social inventions and can only be avoided by some over riding power based on overwhelming physical might. War has been our only cure for war: so, as our capacities improve and abundance increases, so have our wars become more deadly. Hard pressed by a stubborn and pitiless foe half way around the world, we called into council our scientists and reached into the cosmic universe for the thunderbolts of the very gods themselves. Even with the puny weapons of the past, we have all but crushed Europe's culture, friend and foe alike. Can civilization recover from the blows already inflicted on her? Consider what the fate of civilization, our own included, would be if 100 or 1,000 great cities were as Hiroshima and Nagasaki are today. History teaches that no tools, weapons, processes or powers can long be kept as national secrets.

We have now created a weapon beyond our control, a weapon for which there is no protection, no shield, no wall, no hiding place. History proves that man always uses the tools and weapons he invents. To use this weapon might win a military victory, but it would also mean the end of the civilization we have built in the long millenniums of trial and error. We have created a Frankenstein. How can we control his wrath? Once again the

Prometheus has reached into the skies for power and now stands bound to the rocks of the destiny found by self-forged chains while the vultures of greed and fear tear at his liver.

How can a broken world renew its life and faith while this terror broods about it? What future may be charted or dreamed of while this insensate terror hovers over the councils and the hopes of all mankind? All over the world men are hopefully planning for a better and more abundant life; but, to what good purpose when all their dreams may be shattered by particles so tiny that no microscope may ever see one.

This devil's miracle was the child of thought. Man found it first in the realm of thought, and there, too, lies its remedy. We must turn our thinking toward those few great ones who in the past laid down for us the fabric of our moral laws. Men fail to agree on many points. Each age, people and state are ruled by different patterns of traditions. But, all of us can agree on white and black, right and wrong. We have led ourselves to the very brink of the pit by material powers of conquest. Our one hope, our one defense is a clearer insight into the spiritual verities of the universe.

We thought ourselves into this paradox of destruction. Only thought can lead us out of it.

I wrote this book with the hope that some general pattern of culture might be made plain, and that men should think of men as men and not as nations. Man is a master of wonders. His path should not always lead to a carnal house.

M. D. C. Crawford
February 1948

CHAPTER I

ADAM'S ANCESTORS

MAN is the only animal who ever combined curiosity with experience and made the combination pay continuous dividends. He is also the only animal who includes himself and his social affairs in the scope of his curiosity. Here he is perhaps less fortunate.

The earth's crust is studded like a great plum pudding with the bones of the mighty animals who were once his contemporaries and, in a sense, his rivals for the right to live. These other animals could not think, nor dream, nor plan fruitfully and are now "fossils," the pride of museum curators and the delight of paleontologists. But man still gets along, impelled by the wings of his intellect, overcoming natural obstacles by his knack for inventing things, and then inventing synthetic obstacles known as customs, traditions and laws to impede the progress of his mechanical inventions. He is always anxious apparently to change his mechanical inventions, and equally determined to let well enough alone in social matters.

This has been going on for a considerable length of time. According to the geologists (our principal authorities in these matters), the early stages of our race began about a million, or a half a million years ago. A few hundred thousand years one way or another means nothing to a geologist. Nothing remotely resembling man has been found in earlier strata. Let us enjoy (if only for a

moment) the pallid satisfaction of conservatism and accept an antiquity of 500,000 years for a certain animal who then began to act like a man, that is, think, and then try to establish some relationship between his mechanical and social inventions.

Of course we can know of the first inventions only, through the permanent survivals such as stone, bone or ivory. Perhaps, like children, the race learned a lot more in its adolescence than these meager records imply. In prehistory, as in all experimental sciences, a little imagination within the scope of data is essential. At least we must give early man some benefit of doubt; he could not have been a moron or there never would have been a human race, scarcely a pre-human group; nor could he have survived by accident or mere brute strength. Accidents are effects, the causes of which have eluded our vigilance. Greater brutes than man succumbed. Even man had to change in order to survive: he still may have to keep on changing in order to remain among those present.

Man never made tools just for the sake of tools. He made tools for the things which might be fashioned by tools and to satisfy some recognized need for the products of these tools. Back of each tool and implement, ancient or modern, there is always a purpose; indeed, many purposes. Every tool was once an incorporeal thought a dream, if you will. It was first created in mind before it took material form. Thought comes before the use of stone, wood, fire or metal implements, machine, process or system.

We have a right to assume that early man may have made or invented many perishable things within the range of his tools and within the scope of environment

and necessity. Many inventions were intangible; many others have been swallowed up in time. Nature is seldom kind to the works of man, but the ideas from which these things grew are mighty hard to kill.

No one questions that physical man belongs to the animal kingdom. The question is what kind of an animal? If he was not a mentally-plus animal, how has he survived and improved his status and increased his wordly wealth while physically more powerful animals perished? Was not the difference contained in the power of thought and memory, the creative force of related and consecutive ideas? That man chose the firm earth as his home implies two conditions: First, he must already have formed a rudimentary social organization in order to be able to act in concert. In other words, even at our first dawning we are dealing not with scattered individuals but with "society." Second, he must have had some power of thinking—some leadership to choose the road of progress and not the easier path that led to the boneyards of paleontology. Man from the first was clearly destined to build and not merely to furnish specimens for museums.

It was not whim, nor fate; it was thought. Man changes his habits only under powerful stimuli to his thinking. Inertia is his normal state, then as now. Only a few, a very few minds count in any age; the average is inert a force only moved by genius solving necessity and in turn creating the necessity for movement. Other and lesser gregarious animals have made similar decisions. The migrations of fish and fowl, the wanderings of herd animals indicate perhaps as great an intellectual achievement as man's descent from the trees. But at least man met this first obstacle successfully. Whatever

may have been the cause of the difficulty, or the process of solution, he chose the correct answer; whatever may have been his methods, the result was not accidental. But this first move did not make him a man. It is what he did after he came to earth and stood up, how he met his environment that counts. A squirrel on the ground is still a squirrel. The fact that man had moved "to the other side of the tracks" was in his favor but was not conclusive evidence of his social superiority.

The nature of accidentally edged pebbles first drew man's attention; then he began to make tools by intentionally imitating and improving upon the casual accidents of nature. In other words, he used his intellect to increase, diversify and expand his comparatively modest natural physical powers. Somewhat later his curiosity led him to study the nature of the Fire Beast and change this deadly terror into a faithful slave of myriad uses.

No other animal has ever done or even attempted such things. The notions of the cutting edge and fire were never entertained by any beast. These early inventions at once differentiate man from all other of earth's many and changing forms of life. There is less physical or mental difference between the lowest and the highest form of human life than between our most rudimentary hominid and the highest form of the lesser brutes. It is not a matter of the shape and form of bones; it is a matter of the intellect—that strange power that turns difficulties into stepping stones, that feeds on its own mistakes.

A long time after he had learned something about specialized tools and how to create as well as preserve fire, and a long time after he had become a very practical and skillful hunter and a gatherer of wild seeds and

fruits, man put this knowledge to the practical purposes of domesticating certain gregarious plants and animals and making these plants and animals dependent upon him for life: while he, himself, became more and more dependent upon them for food and other purposes, including the use of draft animals to draw wheeled vehicles.

Man cooked with boiling water long before he learned how to make vessels of stone, baked clay or smelted metal. The function always precedes the mechanical invention to facilitate and specialize the function. He used to put hot stones in fluids contained in skins or water-tight baskets to boil his meat. Hence, for ages, he had seen and smelt the vapor, savory with the cooking meat, rise above his fires. But he did nothing about it until a couple of thousand years ago, when this force was used to open temple doors in Alexandria, Egypt, and turn idol's eyes to encourage a waning pagan faith. Then the world dissolved in the fall of Rome and men, pressed with more practical problems, forgot all about this vapor.

In the 16th Century, Hero of Alexandria's *Pneumatica,* originally written in Greek in the 2nd Century, was translated from Arabic into clerical Latin by a German monk, and men began to duplicate these old water vapor experiments. Just at the dawn of the recent mechanical age, men stopped playing with this giant and put him to work and called him Steam!

Next, English Faraday discovered that magnetism and electricity were the same thing, and once this idea hatched out of the laboratory, men found many uses for it. The whole matter is contained on a single page of note paper, but it lights and moves the world and is more potent than all the kings and all the conquerors earth has bred for earth's confusion. And now it is the atom and

the electron, or the chemical nature of the sun's rays which are engaging man's hopeful curiosity. Take man as you will, he was, and is, and gives every indication of remaining, a most ingenious fellow.

But every time man invents some new tool or discovers some new force, however simple or complex, he gets into social trouble. This is because inventions and discoveries change the actual or potential sum of human wealth and make necessary a re-arrangement of relationships between the group and the individual within that partiular environment. So every time new ideas in mechanical things are introduced and accepted, someone has to invent or change customs, habits, laws, codes and constitutions by which the group has lived before the new inventions arrived.

A need for a new invention may exist for a long time, side by side with the opportunity to satisfy this need; but it takes brains and courage to bring the two together. These qualities are rare. No one can tell just when some genius is about to evolve some new mechanical idea that in time will make a rubbish heap of old mechanical ideas and incidentally of established social forms. Hence society is seldom ready for these mechanical intrusions and has periodic phases of academic hydrophobia or political jitters.

New tools and machines, forms of power and systems, prove themselves by demonstration. For example, a stone point vastly improved a plain wooden spear; a bow and arrow was obviously better than a javelin or dart thrower; man could go faster and further on a horse than on his own feet; bronze was better than flint, iron than bronze, steel than iron; a spinning frame with multiple spindles produced many times more yarn than the single

spindle on or off the wheel; a steam engine was more powerful than any draft animal; and electricity more flexible and convenient than steam. An automobile is swifter than a horse; an airplane than a railway train; the radio than the post-office. Even that noble animal, man, has always been able to comprehend such facts. Nor is he slow to make the changes in mechanical things once he understands them.

But political and social changes are another matter. The older a law is and the less clearly it is understood, the more closely man clasps it to his fond, foolish bosom. The forces of tradition and custom are often more potent than reason. Old laws seldom mix well with new tools or machines. Every law we have or ever had, or ever will have, every religion we have or had or are still to enjoy, was once just as much an invention as any visible mechanical device. But for these social inventions, once accepted, man has a strange, often a passionate fondness, since they more often involve his emotions than his intellect. He will fight fiercely and endure bravely for a law or a custom about which he knows little or nothing and which has perhaps been a terrible burden to him. But he will discard an old and faithful tool in place of a better one without a moment's hesitation of sentimentality. Slaves have shed their blood to preserve slavery and have slain their own brothers for some line of expensive and ineffective butchers and idlers. But man changes a hoe for a plow, a canoe for a sailing ship, a horse-drawn cart for a locomotive, a water-wheel for a steam engine, a candle for an oil lamp, an oil lamp for an electric bulb, a bow and arrow for a musket, a rifle for a machine gun, without a sigh of sentiment. Yet, each of these changes meant more to the world than many

codes of laws or social systems. Take man how and when and where you will, he is peculiar, and yet he would not be worth much without emotions, even though he pays "through the nose" for this luxury.

Man has solved and explained many mysteries but his own intellect lies beyond his explanation. This is not to be wondered at since the only measure we have for this force is the force itself. How we make things is clear enough. Why we make them is still a mystery. We may call it Genius, or Inspiration, or the out-pouring of the Good Spirit. We may often dissect its origins in former acts of genius and use such leveling phrases as "association of ideas," "intrusions," etc.,—but we must then explain these terms. The force itself is still a mystery no matter how we phrase it.

We have explained ourselves to ourselves as the descendants of mythical animals and anthropomorphic monsters; as demigods or full-time devils; we have been derived from the rib of a woman or molded from a convenient bank of clay. All of this has added largely to the plastic arts and somewhat to poetry, but little to the realm of fact.

Toward the middle of the 19th Century, a concentrated series of inventions and discoveries of a technical nature and the rapid development of world, ocean-borne trade came in contact with a mass of old political habits of thought, new economic tradition and "sacred" interests. This created a hideous social confusion which needed some face-saving explanations. The evidences of misery were plain enough—had been all too plain for weary decades. It was all right that machines should change, that man should be able to create more and more "wealth" through new mechanical devices. That was

progress! But laws and customs were other matters. They were sacred and not subject to alteration. Ordinary man had to reconcile himself to the idea that the top side was the right side, and that new technical invention must never alter any social *status quo*. So the world faced the curious spectacle of wealth increasing and poverty intensifying at the same time. The philosophers and the better people who read philosophy, were shocked and not without apprehensions. The French Revolution then took the place of Soviet Russia of our day, a thing at which to point the finger of reproach. It was a grim situation as all who read may learn. So the "better classes" developed a philosophy of defeat and destiny which made their pleasant top crust as secure as printed theories and written laws and legal parchments could make it.

Man had invented both the machines and the legal systems that prevented the most fruitful use of the machines. The machines he constantly changed; the laws he held, by some strange confusion of mind, to be perfect and unchangeable. Society was self-shackled by the shadows of its own creations. Like some silly Prometheus, bound to the rock of convictions by shadows, men forced the very machines his genius had created to lift the burdens from weary backs and fill the earth with bounty undreamed of, to tear at his liver like the vultures of the Greek myth.

Man had torn coal and iron from the bowels of the earth; had mixed dreams with intellect and wheels with steam and genius to brim the earth with wealth. Hence men must starve in filthy hovels because certain more fortunate men held magical parchments based on the invention of laws, made and written before men had

dreamed of machines. But in order that men might starve with a proper sense of humility, the philosophers invented "laws of rent," "diminishing returns," "right of free contract," "survival of the fittest," *"laissez-faire,"* and other dogmas which still live to plague economic sophomores and comfort conservative politicians who see in the fructifying Law of Change only the end of their pitiful little worlds.

Thomas Carlyle, in the 19th Century, looking upon these matters not without vision or lack of bitterness, referred to men as "featherless bipeds." But the birds had no standing in court and hence could not sue for libel. Carlyle suspected that man had some other relationship to man besides the payment of wages; he suggested that the universe was not created for profit or for pheasant preserves or parchment deeds. He was a radical and was said to have been cross to his wife.

A little later, the world of letters was rent into scraps of paper in an effort to determine whether man had descended from the angels or risen from the apes; whether we had come from the heavens on celestial wings of imagination, or had climbed and wriggled and crawled out of the slime of primeval seas, guided by some strange blind force called Fate or Nature.

Neither, my friends; we are neither angels nor devils, newts nor anthropoids—but men—Titans with our heads in the clouds and our feet on the kindly soil.

Invention, as I hope to prove later, tends to occur in relatively short eras of time and within definitely restricted geographical areas. The fact that certain of the simpler inventions seem at our present state of data to have had multiple origins in no way modifies this theory. For all invention there must have been a first time and a

first place and a first man. But the next fact of almost equal, perhaps greater, social significance is the strange, almost magical power of invention to diffuse over immense areas of time and space. It makes no difference by what method inventions become dispersed, there is no question as to the facts of their distribution. Whatever the method, the social consequences are the same.

Certain tools, methods of producing fire, the art of agriculture, the wheel, pottery-making, canoes of various kinds, food and industrial plants, domesticated animals, the various phases of the wheel, and many other inventions and discoveries are scattered over continental and sometimes world-wide areas. This force is the secondary essence of world culture. Ideas have no known or determinable barriers, except the power of men to recognize and absorb them. Invention is a matter of the intellect and the distribution of invention is not an accident. The seeds that fall upon fertile ground flourish no matter how, by whom, or from whence they were scattered.

Within recent history we have seen textile machinery, the steam engine, the railway and steam locomotive, methods of producing iron and steel and electricity disseminated all over the world, everywhere creating new social and economic conditions and adding to the sum of the world's wealth and also to the world's economic confusion. The names of High, Crompton and Arkwright, of Watt, Stephenson, Faraday, Whitney, McCormick, Edison and Ford are household words all over the civilized world today. Within our recent past, we have seen the telephone, the telegraph, the harvesting machine, the sewing machine, the typewriter and various other business machines, the phonograph, the radio, the automobile, the Diesel engine, the hydro-electric plant and

the airplane follow even more vigorously the same pathways of world acceptance and world wealth.

But the inventions of social ways of thought, patterns of living, hour and wage scales, rights of property, move more slowly. There seem to be no common or ready media for the exchange of such ideas. Languages and religions, philosophies, traditions and special interests are apparently impassible obstacles to the exchange of social ideas. To the scientist, as to the angels, we are all one great race, sharing common triumphs and defeats, moved by similar needs and impelled by common desires. To the politician, we are broken up into narrow and artificial compartments known as nations, and against these imaginary restrictions the forces of creative mechanical inventions strive strongly. New wine in old bottles. The bottles of the parable were of skin; our bottles are made from legal parchments.

Today, more than ever in our racial history, all nations of comparable mechanical culture tend toward a common technical plateau. Yet all over the same old world there is the effort to make each artificial national area a self contained economic entity.

National boundaries are not economic frontiers. Each mechanized nation has a mechanical surplus it needs at home but must sell outside and is prevented from selling because other nations, through quotas and tariffs and subsidies, armies and navies prevent the free movement of wealth.

Thousands of years ago, among so-called primitive peoples, man invented the idea of trade. Wealth moved from area to area, creating more wealth, greater security of living, ease, luxury and elegance. Trade is as much an invention as speech, fire-making or a monkey wrench.

Trade is the complement of invention; it made and makes inventions world-wide in their social implications and vastly multiplies wealth. But trade is now the terror of small politicians, so they are killing the thing they foolishly fear and thus strangling the world's hopes in a tangle of laws and customs houses.

All over the world of common mechanical invention there is every form of government men have desired, designed, despised and discarded from Hammurabi and before, to Stalin and beyond; from Rameses I to Roosevelt II. Men accept new tools and new machines almost without question, but new social ideas are another matter. It would sound like Alice in Wonderland if the gas and cannon and airplanes were less real.

Our society for two thousand years has developed only one escape for its surplus mechanical energy. This escape is the ancient hag of war, invented on a large scale at about the time domesticated animals and food plants and village life put a value on land and made war-making a seemingly easy way of acquiring wealth. This was the hideous ingredient the devil dropped into our bowl of plenty.

Man has invented many ways to make war. Can he now pass laws to control these inventions or can he find in codes and treaties a way to make peace instead of war? Our problem lies in the balance between mechanical and social invention and falls into the realm of morals. We can find little hope in institutions; only in the individual's processes of thought. The problem can only be defined, not solved by any book.

CHAPTER II

MOTHER NECESSITY AND HER LOVE AFFAIRS

I AM perfectly willing to admit Necessity as the grim and prolific female parent of all invention. But opportunity and genius are equally essential in order that she may perform her natural functions. Necessity and opportunity are more or less common factors actually or potentially present in all environments. But genius is a highly variable and elusive quality; it follows laws too subtle for our comprehension.

I am willing enough to celebrate the all-ages, the all-races Mother's Day. But how about the Fathers? We cannot dismiss the male element in ideas any more than in less obscure relationships. I am interested in the fathers who, in various times, places, races and ages have met and embraced this fecund and ardent lady.

The love affairs of good, old Mother Necessity occur at irregular intervals of time. In the earlier stages of the race the lady waits long and patiently for adequate lovers. Then there occur periods in which her charms make a somewhat stronger appeal. But at rare times her amours become so frequent, and so varied as to amount to a scientific scandal. Today the lady is chronically in an interesting condition and has been so more or less for the past six centuries. Apparently there is no regulation in the matter, no measure of restraint, and of course not the slightest consideration for what the hor-

rified political neighbors may think. Whenever and wherever a genius shows up, the lady is apparently open to persuasion. If no genius occurs the lady's indifference is equally amazing. It is either a feast or a famine.

For example, for 400,000 years, more or less, or for four-fifths of man's visible history, he was satisfied with a few crude implements based on a single technique of stone work, and with the preservation of natural fire and perhaps a few simple social arrangements. Then Mother Necessity, in the form of intense cold and drifting ice, met human genius and in 30,000 years more or less, developed several times the number of tools and ideas than had been created in the long ages which preceded this incident.

There came a vague and still undeterminable interlude (known to the learned as the Azilian Age), as the floods of melting ice devastated Europe and ultimately subsided into the modern geological world we know. And then the paths of the world were opened and the feet of the young men were eager on these paths bringing new wealth, new inventions, new ideas and new hope to the world. The progeny of Mother Necessity, sired by genius, pressed against the boundaries of Europe. There flooded into Europe sheep and cattle, swine, horses, goats, wheat, oats, barley; a new method of stone work, pottery, weaving, the early metals, the building of villages and walled towns, navigable boats, fortifications, great tombs of stone; the dawn of modern architecture and that inspired and priceless gift, the chariot wheel—the infinitely fertile mother of mechanical ideas to come. The intrusion of these basic and epoch-making inventions occurred somewhere between 10,000 and 20,000 years ago. We can trace them surely to 10,000 B. C. in Europe

and perhaps to 15,000 and 20,000 B. C. in the Near East. When they appeared in Europe they were fully developed ideas with a great antiquity back of them.

Egypt, Persia, Sumer, Crete, Mycenaean and classical Greek were the first visible civilizations which sprang from the inventions of the Neolithic Age. As Rome spread her legions and her laws over the ancient world, and founded her might upon the tribute which was exacted from these conquered nations, to the sum of technical invention she made no contribution; even her famous roads she borrowed from Asia Minor. Yet, towards the end of her power, there were gathered in the city of Alexandria, in Egypt, founded by a general of the Great Alexander, of Macedon, a few men of scientific and inquiring mind. We know little of their achievements except through a few scattered records preserved, not in the original Greek, but in Arabic.

From these limited records we learn that Hero, of Alexandria, and his associates scientifically considered the five principal motions by which weights may be lifted "by the application of a given force," the wheel and axle, the lever, the pulley, the wedge and the endless screw. The invention of the screw was the one contribution of modern man to this group of still more primitive inventions. It was used in Archimedes' famous pump to raise water from mines, as the principal mechanical factor in olive oil and wine presses, and to open the jaws of a surgical instrument still used in childbirth. The modern machine age would be impossible without this invention. In Alexandria, man made his first experiments in hot vapor and steam engines. Temple doors were opened, idols turned on pedestals, and water and wine were made to flow by the agency of steam. There is even

some belief that the engine for pumping water was developed at this time. In an age of cheap slave power, there was no impulse, no necessity to carry these experiments beyond the laboratory stage. Like electricity in the 18th Century, steam in the 2nd Century was an elegant science, a scientific toy. Still, men in old Alexandria had come to know something of the nature of this giant. Then Rome fell in the disaster her political and social forms had evolved, and mankind had to wait more than a thousand years before society was again ready to pick up these ancient experiments and carry them forward to the second age of steam towards the end of the period we call the Renaissance. More was reborn in this period than an interest in ancient arts and literature: the mechanical science of Alexandria had its rebirth in Italy, Germany and ultimately in England.

Six hundred years ago came the new birth—the Renaissance. Six centuries is a trivial interval in time, as time is measured by the history of man. And then modern man, spurred by the faint memory of Alexandria, inspired by the almost forgotten secrets the Greeks had garnered from the forgotten East, awoke and invention followed experiment, new experiments flowed from successful inventions. The world had begun again to think. In the midst of a world struggling to get out of walled towns and cloisters, from the safe but restricting environments into an age of world trade, selfishness, brutality and rogueries past count, a world flogged with the whips of war and darkened with the terror of the sickness which "striketh at noon day," and hideous with religion bigotry, men still invented, still gave fruition to ideas.

In the 14th Century, Western Europe, almost driven from the Mediterranean, poked its timid nautical nose

into the Western Ocean and ultimately mastered the world's oceans. Next came the Industrial Revolution, the age of automatic machinery, of steam, steam ships, locomotives, railways, electricity, the telephone, the telegraph, the radio, the automobile and the aeroplane; the industrial scientific laboratory, the age of the chemist, the physicist and the inspired mechanic.

In grading the social status of culture, the learned have placed perhaps undue emphasis on a single human invention, or rather on a single group of inventions, including the phonetic alphabet and the arts of writing, printing and paper-making. These inventions, like all others, arose from necessity, sired by genius. About 5,000 years ago, man's other inventions and discoveries in Asia Minor had become so complex as to create a necessity for records of a more precise nature than either speech or memory or various forms of picture writing permitted. Alphabets and writing were the result. "History" consists largely of the written records of the literate races—or rather what modern man has been able to salvage and translate and interpret within the structure of his own knowledge of these records. To this has been added recently certain archaeological records of the literate races, in order to clarify and modify the written records. But by the time man had taken to writing on stone, on baked clay, papyrus, parchment and even paper, with a flint chisel, a pointed reed, a stylus or a quill, other and more essential inventions had made society almost as complex and composite as it is today. The difference lies largely in the intensity and diversity and productivity of the mechanical content of modern as opposed to ancient society. Already there were intricate mechanical processes, agriculture, art, literature, aristocracies, priests,

rulers, money, banking, foreign debts and trade, slavery, prostitution, surgery, medicine and wars of conquest—all still quite modern. Moreover, our written records largely consist of facts and theories which at the time of writing seemed important to those who paid for the writing. Freedom of the press is a relatively recent and a rather delicate social invention. So there are gaps even in the voluminous records of written history, and these gaps are only partially filled by the study of classical archaeology.

All that happened before men took to writing, all the conquests and defeats, the inventions and expedients to which men resorted in order to live under various environmental conditions, are known as or referred to as Prehistory. The distinction is intentionally invidious. All that is happening today among non-alphabetic people is called Ethnology; and the general information regarding the physical, mechanical, artistic and social nature of unlettered men is referred to as Anthropology, or the study of man. Things are placed in art museums if made by literate people; more beautiful things go into science museums if made by non-writing races. Literacy is assumed to be the first of all virtues. Naturally no man of letters runs down his own trade.

In other words, there seems to be some tacit belief among the academically minded that when man invented alphabets and writing he became a creature superior to the men who had invented fire, the cutting-edge, domesticated animals; created the wheel and the various derivations of the wheel, pottery, weaving and color; had discovered how to change ore into metal and a few other such matters.

I regard these distinctions as super-refined, over-

simplified and unduly scholastic. After all, history and anthropology deal with the life history of a single animal. All that man has accomplished since he learned the art of writing depends very largely upon ideas and discoveries and achievements which fall within the limits of prehistory, or occurred before that theoretical condition known as History.

I am not opposed to the trade of letters. Far otherwise indeed! But I do suggest that had not man attended first to other and more vital matters he never would have learned to write, and there never would have been anything to write about, nor any need for writing. It seems incomprehensible to me that anyone should seriously pursue the study of history or its stepchild, political economy, without some rudimentary understanding of the material culture which precedes history, as history is defined by the invention of writing. Herodotus has been called the Father of Modern History. But the Sumerians, the Egyptians, the Assyrians, the Hebrews and others preceded this worthy Greek. And even so, they cover only the relatively brief period of 5,000 years. This leaves to prehistory at least 195,000 years of human activity to account for.

The study of anthropology is the most recent phase of history. A hundred years would generously include its chief discoveries, its recognition as a part of the record of man. So far, the most intensive studies have been conducted in France, England and Egypt. But latterly the ancient civilizations in the eastern end of the Mediterranean, China and Asia Minor have attracted considerable attention. And of course great progress has been made in the study of the races which preceded the Europeans in the discovery of the Americas, particularly in

Central America and Peru. Still, the science is new, and the time has not yet arrived for too precise generalization.

Many of the records which I propose to use in this book will be drawn from European archaeology and, where convenient, I shall use the names applied by modern science to the various periods. In other instances I shall draw from the increasing data concerning the primitive peoples of the Americas and various other parts of the world. But my references to these matters will be in relationship to the development of tools and processes and their relationship to general sociological conceptions rather than any attempt at an inadequate résumé of the entire subject of anthropology.

One branch of this new science deals with the physical changes which have occurred in the race since a man-like animal became scientifically visible. All that remains of our earliest ancestors is a few bushel-baskets of scattered and dubious bones found by accident in various parts of the world. These bones clearly indicate an animal as like us in many points as it is unlike us in certain details. Not all of these skeletal remains are believed to be our direct ancestors'. There is a tendency to classify them in various groups and qualify their significance by adjectives differentiating them from the *Homo Sapiens* of the last thirty or forty millennia, which includes our not unworthy selves.

With these distinctions we have nothing to do. I do not doubt the accuracy or the knowledge or the sincerity of the investigations. Nor do I question that much scientific information has already been gathered; nor that in the near future more precise conclusions may be reached as to the relationship between physical and intellectual

man. I simply state that these considerations are beyond the scope of this narrative. I do not care what the shape of man's skull was, or the capacity of his cranial cavity. I do not care whether his legs were bowed, or his back bent under the memory of the bitter burdens he once had carried. As soon as he makes a tool to produce an implement he becomes, for me, a man and a brother—the first creature to set in the animal darkness about him a mechanical light to guide us. If he is not *Homo Sapiens* to the anthropologist, he is at least the intellectual ancestor of all tool makers.

Between man's tools, implements, processes and man's physical and mental structure, there are most significant relationships. Inventions and discoveries must precede the changes in physical and mental structure, and were, indeed, the contributory factors in these changes. Man invents tools, tools "evolve" man. Man could not invent a tool beyond his physical capacity to use or mental capacity to understand. Hence his earlier tools represent the limitations of his physical and mental capacities. Every tool must have started as an idea, a thought caught in the mashed web of a man's intellect. This is only a complicated way of stating that man, himself, and all his achievements are the fruit of thought.

Physically and mentally, man (even as his culture) is the product of the tools which his intellect has from time to time invented and his tools are the fruit of his thinking.

Somewhere, sometime, there must have been a creature who marked the line separating the animal from the man, the flesh from the spirit. When our first ancestor stands there at our first dawning, glowering in the dark and dangerous shadows about him, eager yet hesitant,

fierce yet timid, he sees around him only the limited opportunity to supply the instant necessity for security and food. But actually he is looking into a potential world-wide environment which contains all of the forces of nature as yet untamed; all of the raw materials; all of the ideas, tools, implements, machines, religions, social systems, laws and customs which his recurrent needs are in time to fashion into the world we know.

CHAPTER III

FIRE AND THE CUTTING-EDGE

As recently as the forepart of the 19th Century, the better class of learned men in England had solved the Riddle of Man and had permanently fixed his place in the universe. Adam, first of men, and father of man, was a farmer, born on the 23rd day of March, in the precise year of 4,004 B. C. To question this was not only heresy but stamped the interrogator as ignorant; that is, one unfamiliar with the written records which in Latin, Greek, and Hebrew contained not only the sum of then present human knowledge but the source of all future wisdom. Bishop Ussher's chronology was final, dignified and satisfactory. Thus sense and nonsense are divided by date lines. To be learned is one thing; to remain so is another and a somewhat more difficult achievement.

The fact that curious stone tools had been found from time to time in association with the bones of elephants in the ancient clays of England in no wise disturbed the serenity of the academic mind. John Bagford, in 1690, had found in Gray's Inn Lane, London, what we now call an Acheulian hand ax, and a century later John Frères had found a large collection of similar implements, together with the bones of the ancient elephant now known to have lived in England a few hundred thousand years ago, and hence, somewhat before Adam's dated birth and somewhat before men took to writing books, and when England had been not an island but a tropical jungle connected with the continent.

The stone tools were dismissed as imitations by uncivilized man of familiar metal tools, or as the results of lightning striking the earth. They were called "Thunder Stones," a name of great potency, containing at once an explanation and a mystery. People have always been interested in lightning and having come to know a little about electricity, rejoiced in such an explanation. Popular judgment ascribed these thunder stones to the elves and gnomes of current myths and they were highly prized for their occult powers. They protected houses from lightning and made cows give milk. Every lettered man knew that Caesar had once invaded Britain and that the Romans had borrowed elephants from Cartaginian Hannibal. It was all in the books. What were a few rudely chipped flints or discolored bones compared with the garnered wisdom of the ages distributed by the printing presses? What was a rudely made stone tool compared to a Greek phrase, or a bone to a line of clerical Latin?

But trouble lay ahead for that benign and serene academic contentment. In the year 1836, C. J. Thomsen, the Danish scholar, published the results of twenty patient years of investigation in the kitchen middens or rubbish heaps along the Danish coasts and in the Scandinavian peat bogs, and classified the history of man into three technological groups—Stone, Bronze and Iron.

In the forepart of this same century man became curious about the crust of the world and began to examine and compare the crust itself rather than delve into the classics for information. Aristotle and Plato, St. Augustine and St. Aquinas were all right but they were a little vague, about glacial deposits and igneous rocks. So the sciences of anthropology, geology and

paleontology—man, rocks and old bones—moved out of the Greek and the Book of Genesis into the realm of comparative criticism. The learned were in for a disagreeable time. Facts swallow formulas.

For at least a century before this, man, particularly in England, had been exceptionally active in inventing new machines for the production of wealth, or more correctly, in modifying old inventions so as to increase productivity. Between 1734 (the date of John Kay's flyshuttle), and Thomsen's memorable book in 1836 on early human culture, there had been an astounding number of inventions which changed not only the mechanical horizon of all cultures, but which profoundly altered all existing social relations. So deeply did these new machines enter into the affairs of men that manufacturers of cotton and iron toward the end of the 18th, and in the forepart of the 19th centuries were recognized as almost the social equals of landowners, squires and noble lords—that is, if they were rich enough.

Now this century (between 1734–1834) included the basic inventions of the textile industries, particularly cotton, the steam engine, the steam ship, the locomotive, the fruitful combination of the railway and the locomotive, and also Faraday's epoch-making paragraphs and experiments which proved that magnetism and electricity were the same force. It included vast changes in all methods of production, filled Australia with sheep, America's South with slavery and cotton, and turned the nations which did not have steam or large navies into English provinces. We call it the Industrial Revolution. Regardless of its name, it should have robbed all technical miracles of amazement.

In the year 1849, when these and other matters were

in a general state of flux, Boucher de Perthes published the results of his studies of flint tools, obviously made by man, which he had found in the diluvial gravels of the *Somme,* near Abbeville, associated with the bones of animals believed to have been long extinct before man troubled this otherwise peaceful planet.

The facts of the Abbeville gravel beds went counter to what was written in books and to comforting formulas. So a bitter controversy arose around de Perthes' lucid investigations. Even Cuvier, one of the greatest of naturalists, spurned de Perthes' conclusions. According to this worthy man, there had been a greater and still earlier flood than Noah's which had cleared away all confusions. In this flood every living thing had been destroyed. Man came after that flood and hence, if evidences of man occurred with these older bones, either these observations were not accurate or the observer was a liar, or probably both. A theory that explains everything is never willingly relinquished even by genius.

But after fifteen years of controversy, de Perthes' flint tools were accepted at their obvious face value and then it was discovered that however ancient these tools were, they were by no means the first tools, but evidently represented a considerable development in the art of toolmaking. Back of the Acheulian hand ax (a highly symmetrical and well balanced implement) lay a long series of ruder tools, leading back to an idea of even greater and more astounding antiquity.

In the year 1867, the Abbe Bourgeois found a number of rude flints in the upper Oligocene Strata (a tertiary period between Eocene and Miocene) not supposed to have contained evidences of man, and the controversy started all over again. These stones were regarded by a

few as the deliberate acts of man, *i. e.*, as human inventions. But by others they were looked upon as accidents of nature, due to stones being struck together in the currents of rivers, by the waves of the seas, or by pressure of a geological nature. Comparisons were drawn between them and flints ground up in chalk mills or crushed by cart wheels. This controversy is by no means entirely ended. There are still doubters, but the general weight of scientific conviction now accepts the majority of these chipped pebbles as our earliest recognizable tools, the inventions of, if not a man, at least of a hominid or a man-like creature. They have been well named eoliths, or dawn stones, the first cutting-edge of human invention.

Since man's tools (of which we have if by no means a complete, yet a most ample record) show a definite progression from the simple to the composite, from extreme crudeness to exquisite perfection; since these developments in each investigated area indicate some relationship to time measurements; and as each tool evidently grows out of previous forms, it must logically follow that there must have been a time (if we could but ascertain it) as definite as the date of the Christian era or the discovery of America, or the invention of the telephone, when man was a tool-less rather than a tail-less animal. No child, even in this mechanical age, is born with a tool in his hand, or with any knowledge of how to use tools. It was thus with the race. No one ever started the race out with a chestful of tools or with a knowledge of how to use them. Man had first to perform necessary elementary functions without tools, and as these functions became more and more definite, more and more specific, he was compelled to invent first the idea of a

tool and then each separate tool. In other words, before he conceived of or invented a tool he had to know just what he was going to do with it. Otherwise he would never have invented a tool for the simple reason that it would have been no use to him when made.

Modern apes sometimes make occasional but temporary uses of sticks and stones. There is no recent or fossil ape that compares with man either in the size of his brain, in the power of his intellect, or in the intricate structure of his hands. So we have a right to assume that the first man who came out of a tree or materialized from a myth, had at least as much knowledge as any ape of the nature of casually found stones and bits of wood. When some hominid, some man-like creature, was impelled by his own thinking to stand more or less permanently upon his hind legs and thus give his forelegs an opportunity to become arms, and his forepaws leisure to become hands, he no doubt already knew a little about stones and wood, and made occasional use of this knowledge.

In time, man's curiosity led him to study a little more the nature of stones. They were different from all other substances: heavier, harder, stronger and sharper. They interested him; he began to note their differences rather than their similarities. If you will look at the variety of pebbles in the next brook you cross, or on some exposed hillside, or along the seashore where the surf rolls the pebbles against each other, you will observe the variety of forms and textures in stones. Some of them tend to wear into smooth surfaces and to be rhomboid in shape; others tend to break up into more or less sharp edges, quite capable of rough cutting. We may be sure that our earlier ancestors saw no less than we. All primitive peoples are constantly studying opportunity in environ-

ment. Examine any primitive culture and you will be astounded at the variety and number of things of use they have found in relatively limited environments. All nature has ever been a laboratory for the race.

A proof of this power of investigation by primitive man is his judicious selection of his lithic raw materials. Wherever we find stone tools or implements, man has always chosen the most suitable raw material for his purposes. Sometimes he is limited in his choice by his environment. But his choice is never haphazard; he always uses the best he can find and even in later ages actually conducts mining operations or engages in trade for the finest grades of stone. All over the world man's choice falls upon obsidian, jadite, jasper diorite, quartz, certain close-grained limestones and, wherever possible, his stout old friend, flint. His choice of hammer stones is equally judicious. He chooses these for weight and toughness rather than for their tendency to split in razor-like edges. He knew his stones, not as a geologist, but as a matter of practical experience.

It seems a reasonable supposition that man discovered natural stone edges before he produced or invented an edge by the first fracture method. He was a hunter in a small way, feeding upon such animals as fell within the range of his physical powers. Nor must we regard him as a lone hunter. The picture of the so-called natural family, male, female and adolescent offspring, was created by the idealists of the 18th Century who knew nothing about primitive man, living or dead, and who created a myth of the noble savage living in a sort of paradise, or golden age of innocence. Fortunately no such man ever lived on this earth. Man is not a turnip. Human society, even in the lowest form in which we find

it, is already a relatively complex affair. The Australian bushmen do not store food and know nothing of metal or domesticated animals or plants, and do not build houses, yet they have invented complicated social and religious organizations and a system of marital relations difficult even for the scholar to understand. Even the Tasmanians (who were destroyed during the late 19th Century and who were much lower in technical culture than the Australian bushmen) had invented highly complex social relationships. It can be stated that our earliest knowledge of our ancestors, living or dead, indicates that we are dealing not with scattered individuals nor mere sexual units but with organized social groups.

It is therefore within the scope of probability that, even in the earliest stages, human hunting packs, with some kind of social organization, pulled down and destroyed animals of considerable size, and that the division of these animals presented not alone economic and social problems, but technical difficulties as well. In other words, the animals had to be cut up before they could be divided with any degree of satisfaction to the group. Naturally edged stones may have been found convenient for this purpose. Man picked them up as he needed them and discarded them as that particular moment of need had passed. He may even from time to time have retained some specially useful stone—that is, a stone with a better than average edge. This was of course Discovery; through his observation he had learned and did not forget that sharp-edged stones cut meat and perhaps wood.

There must have come a time—a first time—when some man conceived the idea of imitating or improving upon Nature by either actually producing an edge or

improving some edge he found in Nature. This was Invention. He had discovered not only a tool and the theory of the edge, but invented a process of manufacture which was in time to yield him many tools. He no longer had to rely on chance for his tools.

There he stands in the vague labyrinth of the tangled ways of the past, a flint pebble from the river bed in one clumsy fist-paw (not yet by any means a human hand), and in the other, a striking stone; an idea, composed of several ideas, has developed in his brain, and he strives to direct and coördinate the rhythm and direction of his blows in accordance with this idea. The hammer stone descends and strikes off a flake of flint; and another and still another, while he runs his thumb (not yet developed into that vice with which future men will hold more intricate tools, but already differing from his blunt fingers) along the forming edge. The result seems good to him: it will cut, after a fashion; it was the best edge on earth at that moment; it is adequate to his needs. It is his own, as much a part of him as his eyes, his brain or his hands.

Mechanical theories grow out of the observations of mechanical facts and the nature of practice and experience. So this man does not grasp the full theoretical significance of his act. His tool is satisfactory for his limited purposes and this is all he cares about. For him it is a finished product, an ultimate; for us it is the crude beginning of tools.

A cutting-edge of stone and wooden spear sharpened by this edge and a few stabbing bones are about all the physical evidence the ages have preserved of this man's invention. Among his invisible inventions may be reasonably included some knowledge of group hunting (a little beyond the wolf pack) and perhaps some form of traps,

such as pits, concealed along the runways of the game. But these inventions cannot satisfactorily account for the slaughter of the great beasts he fed upon. There is incontestable evidence that this man successfully hunted the sabre-toothed tiger, the great ancient elephant, the hairy rhinoceros and many other powerful beasts, with weapons which seem and were wholly inadequate without some other aids. The explanation of this fact is sought in his invisible inventions.

Before man could conquer these great beasts he had to conquer the greatest beast of all—Fear! Now Fire was the visible and intangible impersonation of Fear. It was, and still is, the most terrible of all beasts, the most mysterious of all forces. Its appetite includes all living things, flesh or fowl, wood, man himself; in fact, everything except stone and water. It knows no barrier; it knows no fear. Man knew and dreaded fire in all its forms —the lightning that flashed out of the dark bosom of the cloud and shattered the great trees into splinters in its flight; the fire that rumbled in the belly of the mountain to burst forth in billows of smoke and incandescent rivers of destruction; the fire that swept through the dry forests and across the reeded plains in waves of devastation; the stealthy fire that crept by night up through the valleys, choking man with its breath before it penned him against the hills and seared his flesh to ashes. All these he feared; feared them above all other beasts; feared the sight, the scent and the crackling voice of Fire.

This dread he shared with all other created animals. Yet in one thing he differed from them. For as his terror grew, it added to his curiosity until his curiosity conquered his fear and he began to study this monster with the idea of taming it. He never questioned that fire was

a beast—a living thing, for he had no conception of any force without a Personality. He did not know then what fire was any more than we know today what electricity is. Yet hundreds of thousands of years before he dreamed of taming the lesser beasts, he decided to tame Fire, the greatest beast of his experience. This is the kind of courage that built the race.

The secret of the matter lay in fire's appetite. This he discovered by processes we now call thought, composed of experience, memory, coördination of past experiences and present experiment. While Fire devoured all things it had a special affinity for the very things men cared least about such as grass, dry leaves, and wood. This of course was a point in its favor. But this was not the full secret. Fire's greatest strength lay in the fact that the more it ate the greater grew its appetite; and here lay its weakness. A fire with little to feed upon was not dangerous. It could be stamped out; it could be smothered with a few handfuls of earth or drowned in water. It was a thing of naught. But the more it fed, the more it gorged itself, the greater its appetite grew until the whole world seemed involved in its feeding.

When man was stuffed with meat he was disinclined to hunt until the torpor wore off. Even the sabre-toothed tiger was comparatively innocuous when gorged with his kill. When man and tiger were fasting they were most to be dreaded. But when Fire was gorged it was most terrible. Fire on short rations was mild enough to be tamed. The trick lay then in the judicious feeding of Fire!

How else could fireless man have reasoned about fire? How, lacking such knowledge, gained by observation and experience in his wordless and phraseless understanding,

could he have conquered Fire? He conquered Fire with his thought; he possessed Fire first in his mind.

In this conquest he conquered more than a willing slave of many uses. Here lay his first great triumph over the fears which had dulled his mind and stifled his fruitful thinking. By day he was a hunter of no mean parts, as the scattered bones of his feasting yield ample testimony. But by night the hunter became the hunted. The darkness was filled with the prowling hunters of meat, silent of foot, keen of eye, beyond man's power to avoid, and with all manner of terrors and apprehensions which man's dawning imagination conjured up. Even today the primitive man living in the jungle is a restless sleeper. Even today the child fears the dark. But ancient man's manner of living made increasing demands upon his intellect. He could not shiver all night in abject terror and by day conduct his affairs properly. He needed something he could neither define nor name; he needed frequent and recurrent periods of creative leisure free from Fear. Fire was not so much a matter of warmth. The climate he then lived in was not cold. Primitive man was almost immune to cold. Fire for this man meant security, a place of refuge; a hot-house in which the seeds of the intellect might grow into fruitful thought and mould action. Man's mind cannot hold thought and fear at the same moment. To man alone Fire became a friendly thing toward which, as darkness crept over the jungle, he hastened with willing, eager feet; there alone in all the universe lay the balm of peace, security! It was as if between him and the perils of the night there had arisen a living, leaping, tireless ring of spears. The arching dome of light above him was man's first tabernacle, the first place in all the world where thought might rise above the flesh and the

freed spirit grope its way toward the stars—those fires set in the upper air to guide the hunter to his ghostly home. Small wonder then that man in time came to regard Fire as a sacred thing.

But Fire brought with it a new set of social responsibilities and limitations. I have suggested that men already had some loose form of government. Enough, at least, to live and hunt and defend themselves as a group rather than as scattered individuals. The individual and the group were one in emergencies. But this was not enough. Fire demanded individual care and only gifted, experienced individuals could be trusted with so great a responsibility. All over the primitive world there was to grow up a most intricate technique of fire tending and fire preservation. Here, as in other matters, man was a careful and a prudent student; a seeker in his environment for the best materials. Fire must not only be constantly but most prudently fed. Its food had to be gathered, prepared and used with great judgment. It must neither grow too great nor yet too small. Here clearly was a full-time occupation for a specialist and here we have our first faint glimpse of the shaman and the priest and the first magician. The Fire and the Fire-Tender must have in turn become one in the mind of the Fire group. Such a one of course must eat, nor could such precious knowledge be exposed to the perils of the turbulent hunts. Hence he must be fed and protected and preserved from the hunt. The servant of Fire became the Keeper of the People.

The meat the Fire-Tender ate was the first form of taxation; and the Fire-Tender was the first public servant. Social functions had already begun to specialize before hominid became man.

As the grim hunters warmed themselves beside the fire at night, they must have pondered on the recurrent miracle of this tamed demon. Fire had the sharpest tooth in all the jungle; sharper even than their wooden spears. Fire ate wood; perhaps a nibble at a spear point, just to show a friendly attitude, might not be out of place. So a time came when man discovered that Fire was appreciative, it yielded a sharper and a harder point once the charred wood was scraped away. Here is the first industrial use of Fire. Man also perhaps made little gifts of fat and meat which Fire seemed vastly to enjoy and returned grateful clouds of pungent smoke as evidence of its satisfaction. The taste of the cooked meat salted with ashes was also most satisfactory to man. A bit of meat hung over the fire on the tip of a spear till fire had licked it to a crisp was a delightful morsel. And here we have the dawn of the arts of cookery.

Once man learned the many advantages of Fire it became for him a prime necessity. The fact that he once had lived without Fire made no difference; life without fire was now unthinkable. But in order to live with Fire the group had to learn the rudiments of good manners. The strong and the wily might occupy the best seats at the fireside but none within the group might be denied. No one "owned" the fire. It belonged to the group just as each member had a share in the great animals slain by the group, regardless of whose spear first struck home.

Among the few facts which have come down to us regarding these vague, man-like creatures are the clear evidences of their successful hunting of the greatest brutes that man ever made his constant prey. They killed and ate, among others, the ancient elephant, the hairy rhinoceros, the hippopotamus and the saber-toothed

tiger, and left us their bones as proof. The evidences of these hunts are undisputable and they obviously require some explanation beyond the mere discoveries of a few bits of chipped flint, pointed bones and the rarer tips of wooden spears. They imply at once group hunting and a social organization consistent with this fact.

It must be obvious to even the most reluctant imagination that these great beasts could not have been slain by any single spear, no matter how strong the arm that drove it, or how stout the heart of the hunter. These primitive hunters were not out for sport; they were out for meat. Such veritable mountains of meat could have been of no use to a single hunter but would have been a considerable advantage to a group or tribe of hunters.

The races who followed these earlier and ruder hominids belong in the same physical group as modern man (*Homo Sapiens*). They have left us great heaps of the bones of the slaughtered wild horse, the bison and the reindeer, proving that they had developed both the weapons and the social organization necessary to the dangerous and difficult problems of herd hunting. Of course, the only proof they furnish us are the weapon points and the great deposits of animal bones and their cave walls covered with the pictures of the animals they once hunted. But the reindeer hunts of the Eskimos of today and the recent bison hunts of the plains Indians of the United States, offer us adequate and more recent analogies.

These later hunts were minutely organized and the tribe became a military unit under strict discipline, guided by past experience based upon traditions, and under the leadership of skilled and successful hunters. We have a right to assume that an equal discipline

existed in the earlier herd hunts of the last men of Ice which are to be considered in the next chapter.

By no means do I wish to imply that the earlier hominids we are now discussing, the men of the First Ice, reached anything like the organization and discipline of the later herd hunts. The tracking down of single animals and killing them was a different and far less dangerous matter than hunting well organized herds protected by adult male leaders. But, still, some organization was necessary. A disorganized mass of spear men, each one acting on his own imagination and experience, could scarcely have been adequate for such serious and dangerous tasks.

Hence, some method of transmitting ideas to the inexperienced was necessary in order to make these hunts successful and measurably safe. In other words, man had to invent some means of transmitting past experiences into present action. To call such an invention "speech" is, perhaps, an unwarranted use of terms. The invention of speech is a highly composite matter; it did not happen all at once. We speak of writing as an invention, but before men understood the use of letters, they had used picture writing, symbols and various kinds of signs. There is a whole history of invention, which cannot correctly be classified as true writing, yet which precedes writing and leads to the phonetic alphabet. The invention of speech is also composed of a series of experiments in sound, posturing and facial expressions. Like all great inventions, it has a long and vague background.

All that I assume for this first Fire Group is the beginning of those inventions and experiments which were ultimately to lead to the development of speech and the spoken word, which, of course, precedes all written forms

by aeons of time. And all that I infer is that the Fire Group must have invented some intelligible method of communication, in order to make these hunts safe and certain for the tribe and fatal to the prey. The experienced hunters knew that each animal acted according to his kind, but that individual animals had certain differences governed by various conditions, and that each animal and each condition required a somewhat modified technique of approach. The experienced hunters knew that each spear must be in its proper place and each hunter prepared in advance for the incidents and accidents of the hunt. There was no time for instruction when the elephant, mad with wounds, turned savagely at bay, nor when the huge rhinoceros swept like an avalanche of meat from the river reeds, or when the saber-toothed tiger leapt like a flame of destruction from the mouth of the smoky cave. To meet these dangers successfully and constantly, there must have been some preparation in advance and some way of instilling the experience of the veteran hunters into the minds of the younger hunters, grasping their maiden spears.

The most convenient and, the most logical place for this planning was the one secure spot for men in all the world, the pale of the first Communal Fire. Here man had Light, and here he had an opportunity to study his fellow man and by grimace and imitative sounds, by gesture and pantomime, the leaders were able to convey coherent ideas to the less experienced group. So, in a sense, Fire Light was the first master of grammar, the first theatre, and the scene of our first form of literature, and the Hunt was the first concrete example of social leadership based upon tradition and experience. Small

wonder, then, that the animals who lived beyond the Fire Light feared the babbling by night of these strange two-legged hunters of the day. This murmur of sound, was, in truth, far more deadly than the stabbing spear. It was the symbol of the thought which drove the spears and guided them to success. It was one more barrier the intellect of man had raised between the creatures he hunted and himself—one more rung on the ladder which leads upward.

If we cannot call so rude a method of communication speech, we may at least refer to it as a medium by which thought was transmitted into action—one of the shadowy inventions leading up to speech.

We have followed the most ancient technical and social history of man as it is revealed by data gathered principally in Europe during the last century. It is admittedly fragmentary: much of it is still in doubt; much more can never perhaps be known. The periods which I have already mentioned previously, the pre-Chellean, the Chellean and the Acheulian ages, depend upon a single method of stone tool-making; that of the simple fracture of a complete pebble by striking it with a second pebble or hammer stone. During these ages the climate varied, no doubt, but in the main was moist and warm as the evidence of river banks, coal mines and the bones of animals testify. England was a part of the European continent, Asia was attached to North America through the boreal regions and Africa to Europe by Mediterranean land bridges. Man could then walk dry-shod over the entire world. It was, if man's tools are any evidence, an easy world for primitive hunters to get along in; that is, comparatively simple inventions, both mechanical and social,

were adequate to man's needs for food and relative security. His necessities were slight and so were his inventions.

History is a problem not of years but of the recognition and the solution of difficulties. Man might have lived with the simplest of technical equipment so long as his environment did not make imperative demands upon genius. For hundreds of thousands of years changes had come slowly within a single technical horizon. There had been improvement but no fundamental change. But now a chill breath stirred through the warm jungle mists and leaves withered and died, and the animals grew dismal and restless, shifting about, vainly seeking old and familiar comforts. Bitter rain and cutting hail drove men closer and closer to the comfort of the fire. In the fading jungle, above the rustle of dried leaves, there prowled a new beast, the beast of Cold, who tore at numbing muscles with invisible fangs and left men stiff and lifeless, covered with a strange white mantle which turned to water on the lips. The stoutest hearts quailed before this peril!

The Mighty Ones who dwelt in the North had blown their breath on the race of man to winnow out the weak and forge the strong for a still greater tomorrow. A Voice had spoken in the drifting sleet and snow, speaking a new law of life. "All weak things must die: none but the strong may prevail." And the great icebergs moved from their anchorage of stone that this order might in no wise be denied by puny man.

Here where the cross-roads of Destiny meet, in the very pathway of the mile-high vanguards of the ice, he stands—brother to us in the spirit, let us hope, if a little less than cousin in the flesh. All about him is change,

destruction; trees, plants, and animals—all different, unfamiliar; even the surface of the friendly ponds and brooks at which he had quenched his thirst a thousand times, even these have grown at times hard and brittle, touched by that secret terror that has numbed his own courage. By day he hunts dejectedly, himself hunted by this new peril from the North, and finds new, fierce herds alert to danger, savage and skilled in defense in place of his former solitary prey. Slowly in that grim mind of his, slowly yet inexorably as the Ice moves toward him, he reaches a resolve. Let who else will depart, he will abide the issue. He will abide the coming of the Ice sure only of one thing—his own stout courage. Man is greater than Ice! Ice cannot think.

CHAPTER IV

ICE, THE SCHOOLMASTER

MY somewhat lyrical description of this first and worthiest of all Ice Men suggests a little more precision. He was the first of all homos considerate enough to leave behind him a clear, if limited, record of his appearance, habits, tools and thoughts. He was the first, according to our records, to have had a fixed home and formal burial customs. He was also the last of those vague and socially impossible homos who preceded *Homo Sapiens* or modern and recent man. He lived 50,000, perhaps 100,000 years ago. He had a rough time of it, not only in his own day but in later tempests of scientific discussion which in no wise disturbs his repose.

All of which facts are of moment, but our chief interest in this cousin of ours centers in his appearance on earth during one of the greatest emergencies man ever faced. Stern necessity made definite demands upon genius and environmental opportunities, and forced him to lift himself above his own past and present by the bootstraps of his intellect. There was nothing else to grab. He was our first Self-Made Man.

In spite of later distinctions, his first introduction to the world of science was most informal, not to say casual. Scientists had long suspected that some such physical type of Homo had existed before modern man appeared upon the scene. The idea of Adam had become a little modified in the thoughts of scientists and the book of

Genesis was no longer regarded a complete guide to the study of human remains or a complete explanation of Man. Hence their regret that the first discovery of the remains of such a creature occurred in a most unorthodox, most unscientific manner.

During the year 1856, a group of worthy German stone workers unexpectedly came upon a skeleton in the limestone cliffs along the River Düssel. This was, happily, before Nordic and Aryan myths had deserted the halls of science to enter the maze of politics, and before German workmen had become physical anthropologists by legal fiat. But to all men, at all times, a skeleton is a disconcerting experience, involving not only superstitious fears, but suggesting the police. Most men have greater respect, that is, fear, for the unfleshed pitiful bones of man than they have for these same bones covered with muscles and controlled by nerves and sinews. The coroner is, among all peoples, a most important officer, and, all things considered, rightly so.

Unhappily these worthy quarry men did not lack for curiosity, only it was not of the scientific kind and many of the precious bones were destroyed. Upon this now historic scene there appeared in due, or rather undue time, a belated, elated and horrified German scientist who rescued from oblivion a curved shin bone, a brain pan and a few other osseous oddments. At the moment these discoveries settled nothing but they did unsettle the scientific world for fifty years, and the last ripple of this controversy (long after the scientific storm had settled into the calm of conviction), washed up upon the dry sands of a Tennessee court house, where it vastly disturbed the Great Commoner, the late William Jennings Bryan, and caused the befogged legislature of Tennessee

to look with adversion upon the trees and with vindictive suspicion at Mr. Clarence Darrow. For some rather obscure reason, they resented the suggestion of so useful an appendage as a prehensile tail.

None of these, to us, disturbing incidents could have been contemplated by our distinguished Homo at the time he got himself buried a thousand centuries before the book of Genesis was written. But out of this controversy there came his first scientific name—*Homo Neanderthalensis,* since the limestone quarry chanced to have been in the gorge of Neanderthal, on the Düssel River.

A half century or so later, in the year 1910 (four years before the last World War started), his physical and social status was finally and firmly established. French scientists (not quarry men this time), searching in the famous boneyards of the Dordogne, came upon two cave burials. Here were found not only reasonably complete skeletons of this Homo, but his tools and weapons, and some hints of how he made tools, together with the bones of a fossil bison and a chunk of red ochre. The formality of the interment, together with the contents of the graves suggested, indeed more than suggested, that man had already begun to consider the possibilities of a world somewhat beyond the rude physical world he could touch and smell and see about him. He had already begun to give himself the airs and dubious graces of an undertaker.

Since the more fruitful of these cave burials chanced to have been located near the village of Le Moustier, our good man received a new name—the Mousterian Man. Since then, similar remains have been found (together with tools and weapons and red ochre and evidence of burial customs) all over Europe, in parts of Asia and

Africa, but so far, at least, never, in the New World. There were not many of him but he certainly got around. He was a fixed type, just as real, if scarcer, than the later homos to whom we accord the distinction of being our ancestors.

He was stubby and short, with curved shin bones, sloping brow and thick skull, and perhaps quite hairy; with heavy jaw and a set of teeth meant for tough meat, he was no beauty. At times his lower jaw stuck out like an English bull dog's—protagonous (if you insist), and there was a ridge of bone under his assumedly shaggy eyebrows; he may have been able to pick up larger objects with his feet—altogether a creature most undesirable as an ancestor. He was too near the trees and on the wrong side of the anthropological railway tracks. Hence he is not supposed to be a direct relative of ours. The fact that our recognized relatives were the next tenants of his caves, and that we do not know where the Mousterian Man went or from whence our own relatives came, is beside the question. He was quite too rough for the better people who invented war and slaughter, slavery and slums. All that he invented was a new way to live under difficult conditions, a new method of making stone tools, the idea of making bone tools, a chestful of specialized tools to make a new set of implements, a new technique of hunting and a way to make fire and covering, if not clothing. He also seems to have invented an after life and a series of ghosts and spirits which were to have a great influence upon later ages, our own included.

It must be admitted by all that *Homo Neanderthalensis* was a remarkable man. Hence it may comfort the boys who order large hat sizes to learn that his cranial capacity was one-third greater than that of the present-day

Australian (the black ones, of course), and only a little less than our own. Doubts are entertained however that size and weight of the brain are adequate measures of intelligence. A test made among the faculty of a great university revealed the fact that the most brilliant scholar ordered his hats on the small side. What the brilliant professor thought about his large headed investigators unfortunately is not recorded. But we may go at least this far: a brain is not a pumpkin: the quality of its contents rather than its size is what counts. All of which we might have known from casual observation.

His problems and their solutions rather than his appearance engage our interests. These are connected with the effects of ice and cold. The causes which led to the glaciation of Northern Europe and America are still vague. Three or four times the ice has come down and receded in Europe and North America and there were apparently intermittent partial descents and recessions. With only the last of these movements is the history of man, for the moment, concerned. Man, modern and recent, is more or less the product of the Ice and the solution of the technical and social problems raised by the pressure of the Ice. With the last recession of the ice barriers, the surface of the earth assumed its present geographical form and became the home of modern man.

In a sense, all modern civilization has been nurtured in the fertile soils ground into dust by the weight of the moving ice scattered over the surface of the earth by the fierce winds which blew from the retreating face of the glaciers, or deposited, as fertile silt, by the floods from the melting ice and watered by the melting ice and snows of glaciers, past and present. No less than the Mousterian

Man, if somewhat less obviously, we are the children of the Ice.

Northward along the Arctic coasts and covering Greenland with a mile-deep crust of snow and ice, the great bergs still form and break off drifting southward each spring to melt in the warmer waters. And each season, coast guard vessels patrol these dangerous seas to warn the swarming commerce of the world of this seasonable menace.

We do not have to rely entirely upon the geologists for proof of our proximity to the Age of Ice. The anthropologists have much to say on this matter. Along the fringe of the Arctic Circle, across 5,000 miles of waving coast line from Siberia to Greenland, live scattered Esquimau tribes. Until contact with the whalers, the fur hunters and the explorers of the 19th Century, these people lived adequately within an environment of ice and with technical devices, many of which can be traced back to the material cultures which had matured under the last shadows of the European glaciers. Here we have the living example of a culture which had remained fixed and satisfactory for untold thousands of years under approximately similar environmental conditions: a culture until recent time untouched by the stirring mechanical inventions either of Central Asia or of modern Europe.

According to the geologists, we are still living in a glacial age, or rather in an age when the glaciers have retreated once more to the distant North. There are former records of such recessions of the ice followed by fresh descents upon Europe, Asia and North America. The causes of these ice movements are still obscure. That the ice might descend again is beyond question. All of modern

civilization may be just an interesting interlude between glacial movements. There is no power in modern technical civilization to stop such a force. It would grind down our cities, plow new rivers and raise new hills at its own will, not ours. Under the impact of such a disaster, man might find some power in the atom or in the Cosmic forces he is now studying to avert, or at least modify, this destroying force. He is ingenious and necessity inspires him. Still, such a problem might be beyond even the grasp of modern science.

Mousterian Man knew nothing of Cosmic rays, the atom, electricity, of steam or of metals. These forces were latent in his physical environment but not among his intellectual opportunities. He had to meet the occasion with the means within his environment and within the reach of his knowledge. The first thing he did was to change the age-old technique of tool-making. He ceased to chip a chance-found pebble into a crude cutting-edge and selected a proper nodule of flint, carefully evened off the surface and then, with a single blow, struck off a flake as a new form of raw material for his tools. His needs for implements had become diversified; hence, he must diversify his tools.

Early tools are best understood by their uses, rather than their forms. The brilliance of the ideas are naturally obscured by the initial crudity in execution, and to understand the change in tools, it is essential to consider the environmental necessities and opportunities from which they evolved at the command of genius.

Cold, withering and increasing cold, was Mousterian Man's first problem. Experience gradually and eventually must have taught him that the earlier invention of the open-hearthfire was no longer entirely adequate to

his needs. He discovered that he could not heat all of Europe. Preceding such a lucid understanding, there must have been an elimination of individuals and groups who could not comprehend this obvious fact. The penalty for inability to recognize necessity is death. The conservative in situations of transition tends to disappear. This should reconcile us to abrupt changes; by this power of elimination the race is improved.

As a close student of all forms of animal life, Mousterian Man knew that certain animals lived in burrows, hollow trees or caves and thus conserved their own heat, and to this extent resisted cold. Among these animals was the great cave bear. The bear evidently had the right idea; cold lost something of its power in the depth of the cave. Being a reasoning being, Mousterian Man went house-hunting and smoked out the bear. Then, being a practical hunter, he greeted the former tenant with a shower of blows until the bear lost all interest in the things of this world. Naturally the bear became the principal feature of the house warming feasts. It was a rough, but efficacious, way of treating an undesirable landlord or tenant depending on the point of view. The number of bear skulls in European museums, crushed by blows of right handed men, gives some faint indication of the number and method of these evictions.

Man thus solved his nocturnal problems of living. If he could get to the cave and the fire, he was reasonably safe from the numbing cold. But by day he had to go hunting and could neither carry fire in his pockets, since he had no pockets, nor wrap a cave about his shoulders. Nonetheless, out of the cave he must go or starve.

Again he looked at the bear. Not even the oldest, wisest hunter had ever seen, in or out of a cave, a frozen bear.

That outer, non-edible, hairy husk of the bear must be the secret of the matter. Man himself was hairy but not hairy enough and his hair was of the wrong kind. In the end, man took the bear's hide when the bear had no further use for it, and, in this manner, covering, if not clothing, came into use; and here is, perhaps, the first example of a by-product of industry. He even went further: he ground the bear's femurs into gouges useful in removing fat and flesh from the hides. All along the way the bear had a rough time of it.

How do we know these things? Scientific imagination should not create data as well as conclusions. But the data are present in the form of flint knives and scrapers of stone and bone and carefully, laboriously chipped points which can best be explained as awls for piercing hides for the insertion of thongs. To make so difficult a tool as an awl of chipped flint suggests some definite purpose and implies a kind of covering but little removed from clothing. Such rude cloaks made of Guanacio skins are still the only garment of the natives of Terre del Fuego, who live in a climate little, if at all, less rigorous than Mousterian Man contended with. Similar cloaks are made by the Australians from opossum skins and even the more primitive Tasmanians know this trick. Is it not reasonable to assume an equal intelligence for Mousterian Man, when need and opportunity so obviously met, and the tools we know he created imply such reasonable usage?

The awl and semi-circular cutting knife still survive in the leather crafts and the eyed needle of bone and mammoth ivory are important elements in the material cultures which follow Mousterian Man as tenants of these same caves. No one doubts that these later fine needles

meant tailored clothes in the Upper Paleolithic ages. Why then do not awls, scrapers and cutting knives (entirely adequate to the purposes) prove covering cloaks of bear skin for the Mousterian Man? After all, he did not make such tools merely to confuse historians a hundred thousand years later.

His problems were by no means entirely solved by these inventions. The changes which had affected him also operated upon the animals he hunted. Game now appeared in great fierce herds, restless and uncertain. His new stone technique proves that he recognized his need for better and more efficient hunting gear. Balls of limestone shaped by flint tools have been found in his caves. These may have been used for bolas, to tangle the legs of game. They may have been covered with raw hide and joined to a common center by thongs of raw hide. Such a hunting device still exists on the Argentine pampas, where it takes the place of the lasso. There is also some basis for the belief that the sling was known in this culture.

Here there are at least two weapons of propulsion, that is, weapons which permit of a greater discretion in hunting than is implied by the thrusting spear. But the matter does not end here. Some of the stone work seems to have been notched for binding to hafts in the form of rude hachets and spears, or javelins. If this is so then man must have invented the great idea of the knot, that is, a filletal device which made possible the combination of two otherwise alien materials into a composite tool or weapon. Again man has improved upon Nature for his own needs through thought.

The presence of spoke shaves of flint obviously to smooth the wooden shafts and perhaps to straighten

them, implies that man had grown, for some reason, more solicitous about the form and balance of his spears. Why should he have gone to such trouble unless he intended to hurl his spears?

All these inventions and modifications of previous inventions no doubt vastly improved man's relationship to his environment. Still something else was needed. The conditions of the cold which had so strongly affected man's life operated in no less a degree upon the animals which he hunted in order that he might live. Changes in the fauna had been pronounced. The horse and the bison appear in large numbers and the reindeer begins his long occupancy of Europe, while the mammoth and the hairy rhinoceros still remain. These newer animals had no fixed lairs as in the old warm jungles but wandered over wide areas, seeking shelter from the icy winds and the sparse pastures of the tundras. Man, the hunter, was forced by hunger to follow them. And there came grey, cold days when the air was filled with a deadly frost and the ground was as hard and as sharp as flint itself. There must have been bitter nights when the grim hunters huddled about the fire noted with troubled, pain-flecked eyes, the empty places of absent hunters, once their companions, who would return no more to any fire. They knew that they would find them on the morrow covered with white mounds, gone on a journey, departed on a hunt from which there was no return.

Somewhere, in some cave, some one of these brooding hunters must have determined to acquire a god-like attribute and devise some way to create Fire at will rather than to accept it at Nature's hands. This same idea occurred, no doubt, to many men at various times and in different parts of the world. Prometheus had many broth-

ers. But it had to come in the form of an idea or a thought before it became a fact. Man, the keeper of Fire, and, man, the creator of Fire, are two very different beings.

There are at least eight way of creating fire by friction, but only two of these were available to the actual and technical environment of this man. We know that sparks can be struck from flint by the use of iron pyrites, and we know that this method was known and practiced by the Eskimos, who, as I have mentioned, are regarded as cultural descendants of the later peoples of the Ice. We also know that iron pyrites exposed to the air tends to disintegrate. Hence the absence of iron pyrites in the caves of Mousterian Man need not preclude the possibility of its use. There were plenty of flints that might have served.

But I am more inclined to believe that the method invented was the widely distributed technique of the two-stick fire drill. The wide distribution of a technique is not, of course, a complete proof of its antiquity. Yet it implies antiquity. The two-stick fire drill was in use within modern times in parts of Europe, all through Asia and Africa, in certain parts of the islands of the Indian Ocean, and the two Americas, all the way to Terra del Fuego. It is the most widely distributed of all methods for the production of fire, and is one of the most universal of man's mechanical attainments.

Mousterian Man must have noticed that, in polishing his spear shafts with his flint spoke-shaves, a certain intriguing warmth was engendered through his efforts. He was familiar with fire's dietary preferences and realized that fire preferred wood to stone. He may have sufficiently associated these ideas to apply friction with

wood on wood and in this way developed the first rude two-stick fire drill or friction method of producing fire. At least this is certain: in the next age, and under similar climatic conditions, we find drilled teeth used as ornaments which could only have been produced by some kind of a drill. The drill most logical to assume is the early fire drill. All drills, in all parts of the world, and for whatever purpose used, start as fire drills.

Now man has at his command a power over the forces of nature, a control over his environment which he never before enjoyed and which he never afterward relinquished. He can now carry with him implements to make fire at will. He can wander after the game herds strong in the knowledge that he can produce warmth, light and security for himself when the need arises. It is no wonder, therefore, that Mousterian Man covered an enormous continental area. The possession of a technique to produce fire freed him from the old bonds of the communal fire, while it secured to him all the benefits of fire. He could now travel; and travel maketh a full man.

The imagination, which had coped so stoutly with material difficulties, now created for man unseen terrors—the dawn of magic and the fear of the dead. In these crude ages man first begins the universal custom of formal burials. In his ancient graves we find the implements of stone used in life, the bones of animals he once used as food, and his own bones are often painted with ochre and manganese, the red and black pigments so universally associated with death-cults and magic. Man, in his dreams, has seen the dead return! They have come back as malignant spirits, as real but infinitely more terrible than any living creatures. He seeks in the

invention of protective magic a measure of security from the troubled ghosts of his former companions.

He by no means confined his fear nor his protection to the spirits of men. He had a very definite respect or terror for the spirits of animals, especially the great cave bears which he had dispossessed, slain and eaten, and whose hides he wore.

Between man and bears a curious relationship had sprung up. The bears (whose habit of standing on their hind legs must have made a deep impression on man) had unwillingly yielded man their caves, bones and hides. They had no doubt a prejudice against man. Hence man also had dreams about ghost-bears, fearsome creatures, immune to any human weapons. The presence in the caves of innumerable bear skulls which man must have gathered from many caves, cannot be explained away as mere hunting trophies, like stuffed game of today. They were obviously more than this. In a single Mousterian cave, 800 bear skulls have been discovered and in all ancient caves such gruesome tokens are common. Mousterian Man had at least the courage of convictions and went into the matter thoroughly.

Man knew, through frequent experiences, that when he crushed with a blow the skull of a living bear, some invisible essence escaped and changed the fierce and dangerous creature into an inert chunk of delectable meat and useful fur and bone. Where went this Essence? Did it not return in the vision of nightmare? If man kept the skull, could he in some degree prevent or control these nocturnal perils? By day he mastered the physical bears; by night he did not propose that the ghosts of these same bears should control the souls of men. Here man enters

the dark realm of magic to contend with the occult powers—a grim struggle by no means ended.

Man, from here on, takes more care of the dead than of the living. I do not want to claim too much for this grim creature, nor make too much of a few hundred bleached bear skulls and scattered chunks of red ochre and some few painted human bones found in the earth of his caves. Yet these things are found not only in the caves of Europe, but in many caves distant from Europe, wherever we find evidence of this man. The painted skulls of the Peiping Man of China, no less than his stone tools, connect in one pattern of common thought the ancient cultures of two continents.

In the next age we will encounter an infinitely greater variety of tools, an infinitely greater perfection in the technique of tool-making. Side by side with this improvement in technology will occur an equally greater refinement in forms of magic and clearer evidence of its increasing importance.

At the same time, it is not too much to say that this man-like creature, who first met the challenge of the ice, also released a terrible fear into the world—a fear which was to grow until it filled the world with terror and cruelty and numbed the minds of men; and which has by no means vanished in our own times. The Undertaker and the Witch have survived into the ages of science and even today show little signs of disappearing or losing their influence.

Mousterian Man did a good job. He invented a new technique of tool-making, the first technical change in perhaps four hundred thousand years; he made a greater variety of tools and, by assumption, a still greater number of implements than any hominid before him. He

seems to have invented the knot and the idea of hafted, composite tools and weapons. He discovered the value of caves as homes and invented a method of making fire at will and also covering, if not true clothing. Into whatever Valhalla he may have departed, we should wish him well; he was a good man and a stout one.

Man had first to see spirits, evil spirits in all things, before he could see all things in one good spirit. Man grovels before he can crawl: some day we may even learn to walk intellectually as well as physically upright.

CHAPTER V

LAST OF ICE—FIRST OF ELEGANTS

According to the physical anthropologists the long ages we have briefly considered in previous chapters belong to the Hominids, and not to *Homo Sapiens*, or physically modern man. The evidences of these bye-ancestors of man have been divided into special groups named from the type sites, mostly in France, and in the following order: Proto-Chellean, Chellean, lower and upper Acheulian, warm and cold Mousterian or Neanderthal.

In recent times, similar cultures and skeletal remains found outside of Europe have been given qualifying names but are generally classified within the European terminology. This only means the European types are the better known and not that the races originated in Europe or are older in Europe than elsewhere. No evidence of any hominid has yet been found in the Americas. All human life in the New World and in the Pacific Islands belongs in the group of which we, ourselves, are a part. For reasons at times difficult to follow this type has been styled *Homo Sapiens*, or Man of Knowledge. The separation of man and man-like seems a bit snobbish, but that lies beyond discussion in this volume.

I have no thought of any disagreement with the physical anthropologists; nor do I question the value of their patient labors. Man, or man-like, the creature deserves all consideration. We cannot know too much about him. In the acquisition of knowledge, fine distinctions based

upon facts are essential. But we cannot deny a certain culture relationship with these gnomes and elves of the past, since some of their technical inventions are still a part of our complex material culture. I hesitate to deny a relationship with any animal who has made a tool, however crude, with which to make an implement of usefulness.

All Time measures of these vague ages are tentative in the extreme and must vary in the widely scattered areas and before new theories. But, if 500,000 years is a conservative estimate from an hominid who made any kind of a tool, up to today, then 450,000 of these hypothetical years belong to hominid and only the last 50,000 to homo.

Among the inventions which belong in the longer and earlier period, we must include the discovery and the ultimate invention of the cutting-edge and stabbing-point, two kinds of lithic techniques; the discovery, care and preservation of "natural" fire, and, towards the end of the hominid period, an invention to produce fire at will. The evidence of the successful hunting of great beasts implies some social organization, as does the care of the communal fire. And from the facts, it is no great stretch of the imagination to imply some rude form of sound symbols or human-like speech. Hominid made his contributions even if he took his own good time about the matter. He was an ancestor of ideas if not of the flesh.

Hominid's principal "invention" was modern man. The use of his crude tools established new relationship between eyes, brains, and hands, impossible otherwise. The improvement and the increasing use of tools made possible, almost imperative, a natural selection among hominids of those types best qualified to use tools. The

brain is the only motor ever devised to transmit the power of thought, to charge itself with the voltage of inspiration. The hand is the most intricate and perfect of all tools to carry out the will of thought. Hence modern man is the physical result of ages of broadening experiences with tools and memory based on the influence of trial and error, on physical tissues, bones and nerves; or may we say the material expression of half a million years of thought?

The next 50,000 years belong to races of men of our own type. Again, anything approaching historic precision of dates is impossible. Perhaps 30,000 years belong to those material cultures which do not include domesticated plants or animals, loom work or pottery, the wheel or any evidence of metal. With the dawn of these inventions, we are in the Neolithic or New Stone Age which, in reality, is the first of modern, rather than the last of stone ages. This chapter is concerned with this earlier epoch and with the inventions of the first physically modern man.

Nothing so clearly separates these ages from the past as the first expression of the graphic arts. Mousterian Man had his magical red ochres and black iron manganese, his bleached bear skulls and his rude burials. From these physical facts we may imply the invention of dream personalities or ghosts. But this man mixed his dreams and fears with courage and strove to propitiate and perhaps control the spirit world of his own imagination with the creative arts of his own devising. In many other parts of the world, people at comparable stages of cultures have done the same thing and little, if any, below the standards of these first artists of the Ice.

These arts include carving in ivory in the round, graving, modeling, and painting in monotone and polychrome. There is no question that many works are spirited in expression and of a most distinguished craftsmanship; there is no question that the vast majority are crude and not above or below the average of many other primitive essays in art.

The romantically inclined have referred to the painted caves of France and Spain as man's first art galleries. This is not a compliment although such was, no doubt, the intention. Orthodox art galleries are places where Art is treated as a precious and unusual thing to be separated and protected from life and as belonging to past, and by inference more gifted ages. Upper Paleolithic Man had no knowledge of any such ages. He was sufficient unto himself. His works of art were intended for the very practical purposes of bringing the supernatural forces he had invented into accord with the physical difficulties he faced from day to day. They were not any such trivial thing as Art—they were Magic.

So complete and so elegant an expression of the occult must have had a background of experience lost to us in the wastes of time. But so clear are the meanings of his efforts that we can read at least the outlines of his purposes.

The ivory figurines of pregnant women which appear in the Aurignacian times are clearly parts of fertility rites—sympathetic magic to insure an increase in the tribe. The modeled male and female forms of animals are graphic prayers to whatever gods attend to the increase of the wild herds upon which man depended for his daily meat and life. His accurate knowledge of the physiology

of these animals and their habits is the basis from which, thousands of years later, he learned to tame or domesticate certain of these herds.

The hunting of these herds was a very different matter from the slaughter of single animals, however powerful, in those ages, which preceded the Ice and the concentration of animals into herds. In the past it had been the brains of many men pitted against the dull wits of a single beast. But now man had to pit his address and courage against the herd, skilled and experienced in its own defense against all predatory animals, including man. The ferocity of herds of grazing animals is well known. Man has had to deal with this factor for thousands of years; in fact, still has to reckon with it. In this age, even in Mousterian times, he was forced to invent missile weapons and, no doubt, new traps and more intricate hunting organization. These methods find a reflection in a greater social coördination and in magic.

The old caves are covered, one work of art over another, with pictures of animals wounded in vital spots and often with the darts still sticking in the wounds. These pictures are hints to the spirits of the hunts that darts may fly surely to the mark and man might slay his meat from a discreet distance.

So man invented magic, just as he invented missile weapons, to serve a useful purpose and not as a fine art to pique his vanity. As a matter of fact, most of the famous works of art are in parts of the caves where the light of day has never yet fallen and in such restricted areas that only a few people could have seen them at one time, and only then with artificial light. These pictures were not for the mass but for a selected group of trained experimenters.

Here, for the first time, we came upon the shallow, saucer-like, fat-burning lamp. Light was essential to these magical ceremonies. This lamp survived in ancient Egypt and Sumer, in Greece and Rome, was used in the Middle Ages and the Renaissance, and is still in use to-day in Northern Africa, in the Catholic and Russian churches, was known in Colonial days in the United States and is still in use as a lamp stove, a cooking fire, among the Eskimaux.

In the cave of Les Trois Frères is a picture of the Sorcerer himself. On his head is a rack of antlers; on his face an animal mask; he is clawed and hoofed and tailed to perform a magical ritualistic dance for the increase of herds and the safety of hunters. The whole matter has been placed upon a professional basis. Beyond him lie unnumbered ages in which man is to torment himself with terrors of his own imagination or comfort himself with his own hopes. "Thou shalt not, by any means, allow a witch to live" is in all ancient creeds. A firm belief in witchcraft passes through Greece and Rome into the Dark and the Middle Ages and the Renaissance and only pauses just before the Industrial Revolution. Against witchcraft the Catholic Church and the Protestant Kirk waged a vain and relentless warfare. The only way this curse could be lifted from the cringing souls of men was for man to have the courage to deny its existence; to believe, and declare it to be what it was, an Illusion. Like many another evil which we will later consider, it was only an evil fruit of man's imagination.

In the year 1729, the British Parliament repealed the laws making witchcraft a felony and punishable by the most cruel death, and declared it non-existent. Against this rational and humane point of view, the Scotish Kirk

rose in sulphurous mass. To deny the Devil and his progeny, or all evil, was, in the minds of the Kirk, the same thing as a denial of God, the spirit of all good. Thus, according to theological logic, the doctrine of love was nullified by a parliamentary denial of evil as a compensating force in the universe. Dire consequences were predicted for Scotland. The land was not safe if ignorant mobs could not slay old, garrulous self-deluded women. But the church was in error: Scotland got along very well without laws establishing the existence of witches and sorcery.

A belief in witchcraft is by no means dead in this day of modern enlightenment. It survives in full vigor among primitive races, and in rural communities, as the daily press, from time to time, yields ghastly proof. It is by no means absent from our great capitals where the social costs of palmistry and numerology and astrology, voodooism, charms, magical powders, annually amount to millions of dollars.

Upper Paleolithic Man did not perhaps invent this occult nonsense, but he has left the first visible proof of its professional existence.

In the following chapter I discuss woman beginning her quest in nature for plants of food and industrial value. To this she adds a most lively interest in plants which have the power of purges, emetic and narcotic. In the Swiss Lake Neolithic villages, the seeds of the opium poppy are found. The basis of modern medicine is founded upon these discoveries and almost all drugs used by modern doctors were once a part of primitive magic. And to this extent, modern medicine becomes a part of ancient magic.

At the basis of the new implements which man in-

vented in these ages, lay a new technique in stone work. His creative genius demanded more specialized, more precise, tools. So he invented a method we have named pressure-flaking. From a carefully prepared nodule of flint, he learned to strike flakes and refashion these by pressing on the edge with a rod of ivory or bone. In the Middle Paleolithic Age (Solutrian) he reaches great skill in this method; laurel-leaf-shaped knives have been found, thirteen inches long, almost three inches in width, perfectly symmetrical in shape and only one-tenth of an inch thick. Similar, even superior, workmanship occurs in Scandinavia, in pre-dynastic Egypt and among the Aztecs. This method of pressure-flaking goes round the world: it is one of the most widely distributed of man's inventions.

This new method of tool-making was no accident. This early age of invention would have been impossible without proper tools, just as our age would have been inconceivable without Maudsley's lathe and Wilkinson's drill and other precision tools of the early 19th Century. Towards the last of these ages, man uses for his raw materials for implements, bone, ivory, antlers; and wood and stone for his tools.

Among the inventions of these eras are included the dart-thrower or atlatl; the harpoon; two highly developed missile weapons, and what appear to be the remains of the bow drills for industrial purposes and to produce fire; a sled to be drawn by man (inferred from an etched reindeer bone); and an amazing list of stone tools, drills, scrapers, saws, chisels and gouges used for working bone and ivory and wood. But for us perhaps the most amazing technical invention was the eyed needle of ivory for sewing and a fine cutting-knife of flint for

furs; and the button and toggle. This group of inventions which are so well represented in all collections, clearly and beyond doubt establish the fact that these men invented tailored clothing. Moreover, the fineness and exquisite finish of the needle and the decoration of the buttons and toggles, imply a certain elegance in attire far beyond mere covering. Man had learned to cut, trim and fit and sew furs and skins to fit his own body. It has been inferred that these garments may even have been decorated. Seventeen kinds of paints have been discovered in the caves and most of their other implements, which permitted decoration, are literally works of art. There is no reason to doubt that this feeling for ornament, magical or aesthetic, found expression in clothing.

Professor Sollas believes the Eskimos to be, if not blood relatives, at least cultural descendants of these people. And many inventions, including tailor-made clothing, were common to both areas. The Eskimos are the earth's most perfectly dressed creatures. Their clothing is ideally suited to their environment and lacks for neither distinction nor ornament.

In this age we come face to face with one of the most vital forces in early culture and later civilization—the diffusion of mechanical invention. Even before this age, certain types of tools and stone working were scattered over the earth. The most amazing fact is the diffusion of the two-stick fire drill. How an invention, which seems to have been known in Mousterian times, could have appeared in such widely scattered areas as Asia, old Europe, Africa, North and South America and Australia is a great mystery.

In the Neolithic Age, which is to be considered in the next chapter, we will see Europe deluged with new in-

ventions, particularly agriculture, wagons, pottery, cloth and the metals, copper, bronze and iron. Within the past two hundred years, including our own age, steam engines, textile machinery, new ways of making iron and steel, the steam boat, the railroad and locomotive, and various forms of harvesting machinery, the sewing machine, industrial chemistry and electricity in its myriad forms, and the most unusual and powerful weapons for making war, have become all but world-wide in acceptance and usage.

Invention and diffusion of invention in the upper Paleolithic Age (the last of ice), are only a little less remarkable than in the Neolithic or in our own times.

Let us first consider the eyed needle, which became so common in Magdalenian times. It was known in predynastic Egypt in two forms, one the familiar drilled eye and one peculiar to the copper technique of Egypt; the butt of this needle was drawn out perhaps when hot, and twisted in a loop for the insertion of the sewing filament. Egypt, to the best of our knowledge, made little use of sewing for garments. The needle may have been used in decorating cloth.

Eyed needles, as well as awls, appear in the silt of the Neolithic Swiss Lake villages and were known in the Shang dynasty of China, *circ.* 1,400 B. C., together with tailored garments. The needle is common among Siberian tribes and in Alaska and in both areas is associated with fine tailored garments of furs and skins.

A long needle of wood with a cut, rather than a drilled eye is used by the people of the northwest coast of America to insert weft in mat weaving.

Among the Pueblo people of the southwest of the United States and the Bluff Dwellers of the *Arkansas*

river and the Mound Builders in the Mississippi Valley, the needle occurs with less frequency, but was well known among the Mayans and the Aztecs.

In Peru it appears in many forms—in thorn, copper, bronze, silver and gold. The eyed needle is the commonest form, but Peru, like Egypt, had her own peculiar form. The upper portion of the metal needle, opposite the point, has been beaten out flat and cut in a triangular form. The apex of this triangle is attached to the butt and in the middle of the base of the triangle a little ribbon of silver has been left. The sides of the triangle have been turned in to form a hollow cone and the ribbon of metal curved into the base of this cone to form a loop for the insertion of the filament.

The needle in Peru is used for very simple sewing of uncut fabrics. But its principal use is in the decoration of woven fabrics.

The dart-thrower consists of a piece of bone or wood with a groove to contain the spear shaft and a stop for the spear butt and, at the opposite end, a grip for the hand. The movement in throwing is much the same as small boys employ in hurling an impaled apple from the end of a stick. The dart-thrower has more than twice the range accuracy and penetration of the spear hurled by hand.

This invention is peculiarly advanced in Magdalenian cultures (last phase of Ice Age) in pre-dynastic Egypt to hunt the hippopotamus and the great fish of the *Nile*. It is the principal weapon today of the Australians, is well known in Siberia and Alaska where its use has continued alongside of the bow and arrow.

It was used by the Mayans, Pueblos and Aztecs and, in

pre-historic Peru, was at once a war and hunting weapon and a sceptre.

The harpoon appears in the last Age of Ice, was used in pre-dynastic Egypt, is known today in those tiny specks on the surface of the Indian Ocean named the Andaman Islands and is still a vital hunting weapon in many forms in Siberia. In Alaska it reaches its highest development and greatest variety and perfection. It is used as a heavy spear, cast by hand, as the head of an arrow with the bow, and as the tip of the missile of the dart-thrower. The ingenuity employed in tackle, in floats and drags, and in the perfection of the various kinds of missile, is beyond praise.

The harpoon occurs along the entire Pacific coast of North and South America as far South as Terra del Fuego. It is still used as the tip of an arrow in Brazil and Nicaragua for turtle hunting. It was once used in Peru and Chile. The Pueblo Indians and the earlier Cliff Dwellers of the Southwest of the United States had a crude form of this hunting device and the Cliff Dwellers used it with the throwing stick. The principle of the harpoon is still retained by modern steam whalers who now shoot this upper Paleolithic projectile from a cannon.

Recently, in Folsom, New Mexico, there was discovered a mass of bones of fossil bison, and the extinct great sloth. Mixed with this incontestable evidence of antiquity, were flint points which once were the business ends of darts propelled by dart-throwers. The pressure-flaking of these points is curiously like the Solutrean techniques of the middle Paleolithic culture. The age of this and similar finds has been estimated as

from fifteen to twenty thousand years ago, which brings human life in the Americas within some general time pattern with the last Ice Age of Europe. There still remain those who are unwilling to admit such an antiquity for the Americas, but there are also those who regard with suspicion the sphericity of the earth.

Certain ivory rods found in the Magdalenian caves are believed to have been used with ancient pump or bow drills. These drills may have been used to produce fire and also to drill holes in wood, bone and ivory. Pump and bow drills were used in pre-dynastic Egypt and are still used by the Eskimos and other tribes of Arctic America. In a British cyclopaedia of 1820 these same drills are illustrated as tools used to bore the vent holes in British cannon.

On a bit of reindeer shoulder-bone, found in a Magdalenian cave, occurs a crude etching of what appears to be a snow sled. There is no evidence of any domesticated animal, but, if this etching is what it appears to be, here is the first vehicle, the first invention in the story of transportation.

There is a definite technical connection between the last Ice Ages in Europe and at least two modern industries. The harpoon connects modern whaling with the hunts of thirty thousand years ago; and modern tailor-made clothing still depends upon eyed needles, buttons and toggles and cutting knives, all of which appear in upper Paleolithic ages, and which have been in continuous use in various parts of the world since that date.

But it seems to me that we must add one other invention to this list of survivals—that of roads, or at least trails, marking directions and connecting distant areas

in one common pattern of communication. This was a vital idea; it permitted both man and man's invention to move over the surface of the earth and vastly enriched both man and invention.

For unnumbered and unregarded millennia, sturdy hunters had wandered about Asia, Europe, Africa and perhaps the Americas, pursuing herds of game animals and inventing tools and weapons for this purpose. Both man and beast were driven by the whips of hunger; the roads were hard; the trails were long. Yet early man learned by these experiences. At times, game eluded pursuit or met some overwhelming disaster and the hunters perished in silent misery. At times, game grew scarce and men learned to guard them from other predators. Women searched in the vegetable world for food—anything which might be eaten. In this way, the race was building up a knowledge of certain herd animals and certain gregarious plants, which later was to become the background of civilization's most fruitful inventions.

Man had learned mechanics by the grim needs of the many roads he traveled. He had also learned something from the other wandering bands of men. Nature winnowed out the weak and from time to time nature grew strangely kind, and man rested for a few thousand years before he moved on again up culture's rude ladder to civilization.

Over mountain passes guarded by immemorial ice and the terrible avalanche, through dark forests of mystery and gloom, across frozen deserts or wastes of sand, incandescent in the sun's glare, from bitter spring to turgid water hole, so run the tangles of his unnumbered trails. Along these trails, across timeless, changeless Asia, men

still go about their affairs and scientists still glean in the dust memories of these old hunters. The earliest land trade routes, the first routes of armies, were once the trails of the game herds which men followed for their daily meat.

May we not say that these old hunters, the wild herders, invented the idea of roads, which made it possible for man to move about upon the surface of the earth?

In some such manner, not easy, perhaps impossible, to define, his simple inventions led man to the later and more complex inventions upon which our own technical culture rests. He was a pathfinder in mechanics: a trail marker of invention.

CHAPTER VI

ANCIENT HUNTERS AND NEW CULTURES

THE modern world, so confusingly rich in technical devices, forms of wealth and variety of social forms, begins, not with the invention of writing, nor with the dawn of the classical civilizations, but with two fundamental ideas which arise in the rude age now before us: the cultivation of plants and the domestication of animals.

The old name of New Stone, or Neolithic, scarcely applies to this great age, as we now know it. This technique now includes not only domesticated plants and animals, but the loom, pottery, matting, many forms of the wheel, copper, bronze and iron, village and fortification building, and organized war as a profession of distinction.

So far as central and northern Europe are concerned, this epoch is assumed to begin approximately 10,000 years ago.

It is, of course, much older in those parts of the world from which it spread into Europe. For example, Neolithic inventions occur in Crete as early as 14,000 B. C., in Egypt 18,000 B. C., and in Susa (Persia) 20,000 B. C. From China and India evidence is collecting to indicate almost comparable antiquity: nor are certain Neolithic traits new in the Americas.

In all previous ages, man was a hunter; an inventor of increasing skill in weapons and tools and of an in-

creasing complexity in social organization, but, still, only a hunter.

Now he has become something greater, something infinitely more complex and difficult of analysis.

Out of the East, in two steady streams, one from the Black Sea, up the *Danube,* the other from the Mediterranean, perhaps Africa, new men and fresh ideas came into Europe and laid the foundation not only of modern Europe, but of the world as we know it. In many other and far separated parts of the world, the influence of certain of these inventions was felt. For this movement was neither European in origin nor confined in its effects to Europe. It touched the Americas, the wastes of Asia, Africa and China, and the islands of the Pacific. It was the most universal of all culture movements up to the present age and like our age, it absorbed many previous cultures. Europe is merely one of the later and more concentrated areas of penetration. Man seems to admonish his grim old culture nurse, Mother Nature, somewhat as follows:

"My good woman, times have changed and our positions have altered. I am no longer the waif of your whims, but a man with a mind of my own. I am grateful for your raw materials but, at the same time, and in justice to myself, I must point out that these were of no use to me until I had changed and modified them through my own genius. After a fashion, I am grateful for your stern school of practical experience, but I cannot withhold the impression that it was often more stern than practical, as the sterile culture layers in my former cave homes give ample testimony. I am grateful, to a certain extent, for your wild meats and plants, as often denied as granted, to my hunger. But I have learned certain of your

secrets—enough at least to get along with. Your wild herds, which I once hunted, have now become 'my' sheep, 'my' cattle, 'my' horses (to mention no others), obedient to my will and my constant reserves against hunger. You may have created them, but I re-invented them and gave them new attributes in my own interests. Even your wolf is now my dog. Your wild grass seeds, which once stayed my gnawing belly (when meat was scarce), are now 'my' barley, 'my' wheat, 'my' rice and 'my' maize. I sow them; I guard them; I reap them. I have changed their forms and habits. I store them against the hungry days. I can wander at will with my herds and have no fear of your hounds of famine. I can sit at ease, secure in my harvested crops, and also in my crops ripening for the harvest, and your whips of hunger no longer drive me

"You are no longer dealing with a wandering pariah, a slave of your inconsistencies, but with a substantial citizen growing up in many communities."

This new point of view more precisely separates this epoch from all past ages than any general brilliance or profusion of invention. It also connects this age with our own epoch by the same factors which separate it from the more remote past. It is the first of the modern rather than the last of the Stone Ages. Here, for the first time, and in many widely scattered parts of the world, we meet pottery, man's first synthetic product, composed of clay and the subtle chemistry of fire, a proper vessel for sedentary storage and for cooking vegetable substances; here occurs the loom and cloth-making, the metals (copper, bronze and iron, gold and silver) and new types of furnaces evolved from the potter's oven. Fire now assumes a variety of industrial uses. We also meet new kinds of tools—the stone ax with the

ground and polished edge to clear the surface of the earth for man's plantings and harvests; the digging stick, the hoe, the spade, and, ultimately, in some areas, the plow. Here occur the sickle and the scythe, first made of flint blades set in bone or baked pottery, but ultimately fashioned from the metals. Here, first in Asia, Africa and Europe, comes into use the wheel, first in the form of rollers for moving heavy stones for tomb buildings; later, for wagons and war chariots, the water, spinning and potter's wheel; and, still later, to serve as the basic technical factor in the swarming inventions of our times.

It is a fruitful, a provocative era, stuffed with many things and many new ideas. It changes not only man's social habits but alters the surface of the earth; changes the sequences and emphasis of nature to the pattern of the human will.

But in these ages, man devoted more attention to his weapons than to his tools or hunting gear. Swords, shields, helmets and spears became works of art in the early Age of Bronze; and the warrior became the man of distinction and power. The chariot burials of the late ages of bronze and the early ages of iron were imposing affairs. The hunting of two-legged animals became a major industry, a special and highly profitable undertaking. In the rubbish heap of the old hunters, we found the bones of animals marked by the rude weapons of man. But here we find human vertebra pierced with flint points; for man, that ingenious one, combined the resilience of cord with the elasticity of wood and the bow and arrow begins to make history and to mould public opinion. In ancient graves we find the bones of animals as food for the dead; in these later tombs we find human

sacrifices intended to furnish slave-spirits for the mighty dead.

Trade now reaches beyond local tribal limits into inter-regional, inter-continental areas and acquaints men with new finished products, new raw materials, new tools and weapons, new desires, and vastly stimulates local imagination, both in social and industrial matters. Ideas multiply their value by diffusion; wealth increases by being recognized as desirable in new areas. It was world trade, as men then knew the world. Amber appears from the Baltic and Prussia, not only in the graves of western Europe, but also in the tombs of Mycenaean Greece, Crete and Egypt. The honey flint, mined in western France, spreads over central Europe in the forms of partially fabricated flakes. Obsidian, or volcanic glass, from the Island of Melos, spreads through the Cycladic Islands of the eastern Mediterranean and over continental areas. Swords and daggers, beads and ornaments of copper, bronze and iron; bowls and vases of silver and gold and bronze are followed by ingots of the metals and a knowledge of their working into western and central Europe, and even into England. The glass beads and bowls of Egypt find their way into central Europe, into Ireland and England. Trade has created a certain elegance in life, a desire for satisfaction beyond mere abundance.

In this early exchange, we have a right to assume the importation from the East of perishable forms of wealth, such as wine and olive oil and dyed fabrics of wool and flax. But trade was then a matter of barter and the people of Europe must have made some return for the wealth received. Furs and hides were, no doubt, a part

of this return. The busy forges of the East needed copper and the rarer metal, tin, in order to make bronze objects of trade. Hence, along the old trade routes, mines sprang up and also smelters to cast the ore into convenient ingots for transportation.

But there was still another form of trade: If the East sent to Europe many useful domestic animals, sheep, cattle, swine, goats and the horse, Europe sent back to the East one very important domestic animal, the human slave. Europe, in the Neolithic Age, was like Africa of the 16th, 17th and 18th centuries, a great world market place for slaves. Slaves as burden-bearers, as oarsmen in the Mediterranean galleys, as agricultural workers and, later, as the human elements in gladiatorial combats, were merchandise. The future industrial history of the ancient Mediterranean world is in part the history of slavery.

The invention of trade, or rather of trade between alien and distant groups, created necessities for all manner of otherwise useless inventions. Transportation was a prime necessity. All carrying devices, all harnesses, were first created *for* man as well as *by* man. But draught animals and wheeled vehicles followed and also a ship capable of navigation from island to island and along the shores of the Mediterranean and upon the continental rivers; hence the invention of both oars and sails. Weights and measures were also necessities and, of next importance, was the use of precious metals as a medium of exchange and measures of value; later, stamped bits of metal of equal weight (or as we say, coins) were added at about the time the phonetic alphabet and writing were invented as an aid to commerce with distant peoples. Among these same needs were forms of con-

tracts and bills of exchange and some measure of time in units of days and months.

All these inventions and many others—from a polished stone ax to a literature based upon a phonetic alphabet —are the effects, not the causes, of civilization. The condition we call civilization rests, as I have said, upon two simple inventions, usually associated in our thoughts, but actually starting from separate origins, developing along independent lines (often antagonistic to each other) and joining, in comparatively modern times, in one complex.

One was the domestication of animals for economic purposes which was the work of man; the second was the domestication of plants of economic value which was the work of woman. All domestic plants and animals were once wild species. No domestic plant or animal of today was native in a wild state in western or central Europe; hence we must seek the origins beyond Europe. Here, it must be frankly admitted, we are dealing with a certain lack of data. Investigation is, however, proceeding at a reasonably rapid rate and many areas, while still unknown, are no longer unknowable.

Persia, the valley of the Indus, Mesopotamia and Egypt have already revealed much and give even greater hopes for the future. China is slowly revealing secrets of the first importance. And a somewhat different approach is adding to our knowledge of pre-Columbian America. It is gratifying that modern anthropology deals less in precise and general formulae and more in documented facts. There is even a vague hope of a reproachment with History and a very fruitful relationship with the sciences of botany and geology and paleontology already exists. Still, there may lie beneath the

shallow seas of India unreclaimable evidences; or some grave along the coast of South America, or some mound used for ages as a landmark for camel caravans in Asia, or Asia Minor, may yield evidence to change or modify existing theories. Civilization is often referred to as a drama, which is true enough, if somewhat obvious. But it should be borne in mind that the first acts of this drama were rehearsed behind a curtain still marked "unknown."

All the inventions I have hinted at, and many others, are based upon the domestication of animals and plants, with special emphasis upon the latter. Indeed, man, neither as a hunter nor as a herder, could otherwise have become civilized. Civilization requires a permanent address and a fixed and continuous residence. So long as man wandered after his herds, civilization was always beyond him—will o' the wisp of the horizons. It is true that in the second phase of animal domestication, when man trained the individual animal for economic service, his wandering habits were an assistance in trade between settled industrial and agricultural societies and this aided civilization by the diffusion of ideas. But true civilization is impossible without the firm basis of agriculture. Indeed only the cultivation of one kind of food crops, that of the wild grasses, which, in time, became our great cereals, ever led to the higher phases of culture.

The earlier and ruder phases of herding are little different from herd-hunting. In both cases the tribe follows the herd, protecting it from other predatory animals, and gradually becomes tolerated by the herd. In neither hunting nor early herding does man feed or shelter the animals or act upon the individual animal. The difference between herding and hunting is largely a matter of de-

gree, a little more restraint in slaughter on the part of the herder and a little greater emphasis on man's leadership is all that separates these conditions. But the herd still dominates the tribe and a fixed habitation and civilization are equally impossible while the tribe is forced to follow the herd.

CHAPTER VII

WOMAN THE MOTHER OF AGRICULTURE

WHAT women's specific duties were in the long ages of herd-hunting and in the era of the domestication of wandering herds, we can only infer from the fact that no hunting or herding tribe is entirely confined to a meat diet; no set of primitive industries is strictly limited to the by-products of the hunt or the herd. While man was laying the basis of that intimate knowledge of the habits of animals, which was to lead, ultimately, to the inventions of animal domestication, woman's studies in vegetal forms were as constantly contributing to the welfare of the group and laying the foundation of an even more brilliant future.

Every temporary bivouac or recurrent camp became, as it were, her laboratory for investigation into the vegetable world. Maternal duties, no less than lack of physical strength, kept her from the adventurous and arduous life of the men. The sedentary tasks, the opportunities within a limited horizon, fell to her share. From later records, I am inclined to attribute to her the spinning of filaments into cords. The earliest cords and yarns, except sinews and rawhide, were fashioned from the split straws of wild grasses such as flax, hemp and barks, which are known today as "the basts." Woman learned the nature of these fibers by observation and experiment. Basketry and mat-making also fell within the sphere of her activities; later also, loom-weaving and

pottery-making. No doubt, she first learned of the medicinal value of certain herbs and roots, of dyes and narcotics. But it was her knowledge of food plants which was of chief value to the tribe and the ultimate determining factor in civilization.

Even in the Arctic, the collection of certain clovers, roots, wild seeds and berries, is of importance, and the seasonable migrations of the aquatic and terrestrial hunters were modified in part by the recurrent harvests of these vegetable crops. In more favored areas, richer in plant life, this tendency must have been much stronger. There is a whole history of vegetable-gathering before agriculture. Acorns, grass seeds, roots, fungus, cactus-fruits, and various kinds of nuts, are important elements of diet in various parts of the world before and after deliberate planting, tending and harvesting of crops occur, and long before man became a herder. Tribes in California and the American southwest, where game was scarce, were known as seed-gatherers and root-diggers, and never rose above this level. The Australians still depended upon a great variety of wild seeds, roots, berries and fruits in their desperate efforts to keep above the level of starvation. The natives knew the times for the ripening of these wild harvests and made great efforts to gather them before the birds or animals reached them.

Many of these uncultivated food plants require special treatment before they are fit for food. Wild seeds have to be parched by being shaken in wicker sieves with live wood coals to remove the husks and are then beaten into flour between two stones and washed to expel acids and poisons. This practice is common both in America's southwest and in Australia, to mention no other locations. Many wild food plants contain disagreeable acids or

even poisons which must be expelled by various steaming methods.

Captain John Smith, in the 17th Century, writing of the Powhatan Indians, of Virginia, says: "The chief root they have for food is called Tockawhoughe. It groweth like a flagge in the marishes. In one day a salvage will gather sufficient for a week. They used to cover a great many of them with 'oke' leaves and ferne, and then cover all with earth in the manner of a cole-pit (charcoal) over it, on each side they continue a great fire twenty-four hours before they dare eat it. Raw, it is no better than poyson, and, being roasted, except it be tender and the meat abated, or sliced and dryed in the sunne, mixed with sorrell and meal or such like, it will prickle and torment the throat extreamely, and yet in summer they use this ordinarily for bread."

In a somewhat similar manner, the Eskimos prepared the poisonous roots of the wild parsnip and the Pomo Indian, of California, expelled the acid of acorn flour. In the Amazon and Orinoco valleys the principal food is the manioc root, the juice of which is a deadly poison which the natives extract by a most remarkable and complicated method.

With these pre-agricultural activities man had nothing to do. But he had something to do with the early phases of agriculture. He had to prepare the fields for woman's planting.

Gumilla, writing on these matters, as observed in the valleys of the *Orinoco* and the *Amazon* in the 18th Century, says: "With their axes made of a stone celt, with a cutting-edge at each extremity fixed midway in a suitable wooden handle, they (*i. e.* the men) cut the green stems of the brambles and briers after having broken

them down with their *macanas* or hard wood clubs—the women susequently burning the dry timber. . . . It took two months to cut down a tree. . . ."

Man did his part.

Lucien Febre, the brilliant French economic-geographer, suggests that these peckings and hackings of primitive men in the cause of early agriculture, changed in time the entire character of the vast and brooding jungles of Africa and South America. These great rain forests differ from the woodlands of the North, beyond the reach of Neolithic agriculture, in the great variety of different trees in each area. In the North, the forests are composed of groups of one species, larch, pine, birch, hemlock or spruce; but along the Equator the species are all mixed together in no sort of order. As man made the small clearings, and woman burned the vegetation and cultivated them for a few years and moved on from the exhausted soil, a new order of vegetation was established, a new survival of the fittest under the conditions created by man. Hence, in time, puny man, following the law of his stone ax, fire, and woman's desire to plant things, conquered the forests even as he conquered the beasts.

The division of work between the sexes is based primarily on the differences in physical power between the sexes and upon the woman's maternal duties. But magic comes in time to play an important part. To the primitive mind, all things, animate or inanimate, have special spirits which must be treated with great respect. These spirits laid down certain laws of procedure which must be followed if trouble was to be avoided. Ignorance of these laws could never be pleaded as a defense. Every illness, accident, bit of hard luck, lack of success in hunting, war or love was the direct result of a violation,

knowingly or otherwise, of some of these rules. Even death was not "natural," but was due to some offended spirit or the result of some sorcerer sending an accommodating spirit to work evil.

Birth, age of puberty, marriage, death, hunts, plantings and journeys had each their special protective ceremonies. Body-painting, tattooing, scarification, piercing of lips, noses and ears, deformation of skulls, and many forms of mutilation, such as the extraction or filing of teeth, circumcision and the hideously painful practice of sub-incision, were all phases of prophylactic magic. Most forms of personal adornment, rings, ear-rings, bracelets, hair ornaments, etc., were once amulets or charms to avert evil.

Women, because of their menses, were objects of magical terror to men and were regarded as peculiarly frail vessels in all magical association. Whenever twins were born, the second was always killed under the firm conviction that it was the child of some demon. The famous *le droit de seigneur,* the privilege of the first night (known in our Middle Ages, and attacked in the French Revolution), grew out of a savage belief that brides were dangerous companions until they had been treated professionally by the medicine man.

All over the primitive world, past and present, there is an amazing similarity in these beliefs, customs and practices. These similarities can be due only in part to diffusion. At comparable stages of culture and environment all men apparently entertain similar ideas. After all, man is physically and mentally the same, exposed to identical physical phenomena—sleep, dreams, passion, birth and death, fear and the perils of nature. Everywhere he must seek for explanation, vindication and pro-

tection. Nature abhors a vacuum no less violently than man resents an unexplained fact. He therefore attempts explanation and his explanations are rather the measure of experience and intelligence than of fact.

With such a point of view man cannot, with spiritual safety, handle women's tools, the digging stick or the hoe; nor can woman handle with discretion man's stone ax, his weapons or his magical paraphernalia. No one ever questioned such reasoning; it was a fundamental principle, a conviction—that is, a state of mind which did not admit of reason. Primitive people are conservative. They are reluctant to change their minds; hence, they remain primitive. It was a definitely unsocial act to question magical "facts," and primitive peoples, at whatever stage of culture, deal summarily with innovators; they either make them into gods or offer them as sacrifice to gods already made.

For example, since woman was the fertile one, naturally, she planted the seeds and tended the growing crops. So long as this involved her tools, for just so long this relationship was fixed in conviction. When she moulded clay and formed it by hand into vessels, this seemed a kind of creation or birth just like seed-planting and was woman's work.

But when man invented the wheel and the plow and the domesticated animal, he took over the phases of agriculture dependent upon these factors. And when he turned his wagon-wheel into a potter's wheel, he became the wheel-potter. But woman still took care of gardening, that is, hoe agriculture, and still made pots by hand. There was a spiritual barrier still between the tools and activities of the sexes no matter how far technical culture might advance.

Berthold Laufer in his *The Beginning of Porcelain in China* says: "In the stage of hoe-culture, or gardening, the occupation of women, the potters' wheel is absent. Wherever it appears it is correlated with man's activity in agriculture based on the employment of the ox and the plough." Or again, "technically speaking, the potters' wheel is nothing but a primitive cart wheel turning on its axle. The invention presupposes the existence of the wheel adapted to transportation, and, in all the great civilizations in which, as stated above, the potters' wheel is formed, we indeed meet also the wheeled cart. We further observe, that wherever the potters' wheel occurs, and the wheeled cart does not occur, the former was introduced from a higher culture zone: for instance, in Japan, to which the conception of the cart is foreign and which received the potters' wheel from Korea, or among the Tibetans, who have no wheeled vehicles, and in the midst of whom the potters' wheel is only handled by the Chinese." Again, "the wheeled cart is conspicuously absent in all culture areas in which, as has been stated, the potters' wheel is unknown."

Man only becomes an agriculturalist and a prop of civilization as his necessities lead him to the secondary domestication of individual animals. The early phases of such inventions as the sled, roller, wheel, wagon and plow are shrouded in the familiar mystery of all "primary ideas." Man is his own first beast of burden, his own first draught animal: first as a voluntary worker and later as a slave. He did a lot of back-breaking work in the world as many ancient ruins give ample testimony. The ancient Neolithic dolmen tombs scattered over Europe and Asia, the pyramids of Central America and Egypt and the Assyrian monuments, are only a few of these.

But when man begins to train certain of his herd animals for this work, he adds a vast motive power that has the same effect on the ancient world's economic and social and industrial problems that water and wind-power, in later ages, and steam and electricity had on our own. The influence on civilization of the ox, the ass, the horse, elephant, reindeer and camel as living power-plants has been immense and is still of vital importance.

It may afford some idea of the recent importance of domestic animals, even within this past generation, to state that the partial motorizing of United States farms has lost to the farmers 40,000,000 acres of fodder crops to feed these animals which have been replaced by motors and also has created one of the major social problems of the United States.

CHAPTER VIII

FROM HERDING TO DOMESTICATION—MAN'S FIRST MOTIVE POWER

THE domestication of animals was a serious business, in nowise to be confused with the amiable habit of pet-making, in which both primitive and civilized people indulge. Neither a Bengal tiger in a zoo, nor a canary bird in a cage, nor a trained flea in a circus, is domesticated. Some of our so-called toy dogs have even degenerated from the status of domestication in the deliberate loss of their once useful economic services to man. There seems little relationship between a Pekinese or toy bull dog and his remote and outraged ancestor, the tamed wolf.

On the other hand, within recent times, we have added foxes, mink, racoons and rabbits to our list of primary domesticates, since man feeds and houses them on the modern fur farms and derives economic benefits from them. Before this, man had already domesticated the ostrich for its plumage.

In other words, an animal must be wholly or in part under man's control and must be of economic importance before it can be said to be domesticated. When man domesticated the herd, he took advantage of the fact that the herd had already in part domesticated itself. That is, it lived under the leadership of the adult male herd leaders. The physical power and ferocity of these male leaders not only protected the herd from all predatory

animals, but also determined by right of might who should be the male parents and thus exercised a sort of natural selection in breeding—the survival of the fittest from the herd's point of view.

Before the glaciers changed the Northern world, man had invented group or social hunting of such mighty animals as the mammoth, the rhinoceros, antique elephant and such savage creatures as the sabre-toothed tiger and cave-lion. This was a great achievement; but it had been only one animal against many men; one limited intelligence against many keen minds backed by the memory of past experiences. When the ice descended from the North, driving before it the savage herds of wild horse, bison and reindeer and gradually confining these to the restricted pastures of Europe, it was man against the herd. It is no accident that man's weapons began to change. He was face to face with a necessity that challenged his intelligence. His answer was the missile weapons, tipped with points of stone and bone and ivory —the throwing-spear or javelin, the sling, the bolo, the throwing-stick or atlatl, and the harpoon. He needed weapons that could be used from a distance beyond the reach of the ferocity of the males who protected the herds from all other predators save man himself.

Man later controlled the herd by guiding these leaders. But when necessity prompted him to turn and train the individual animal for his own economic purpose, this ferocity, so necessary to the herd, became an almost insuperable obstacle in the pathway of man's desires, needs and progress.

The danger from male herd animals is still present. Even after thousands of years of breeding and close association with man, the domestic bull and stallion have

to be treated with great care. On the bitter caravan trails of upper Asia, the majority of the camels are either females or castrates. When bull camels are taken on journeys, they are marked with a red ribbon so that the herders may, so far as possible, avoid them. The cowboys of the western plains of the United States at each round-up castrate the male calves and carry .45 calibre revolvers in case some bulls escape this operation. If, for a single generation, man ceased to train the great cattle herds of the world, they would return to a wild state and would be almost, if not quite, beyond control until man should again establish his authority.

When man first dealt with untrained herds, his problem must have been infinitely more difficult and dangerous. Indeed, it must have been insoluble without the invention of castration. How did man ever connect in his mind the ferocity of the male animal with the sex glands? How did he conceive the idea of docile castrates as a means to his control of individual animals?

I am inclined to regard this idea as the combined results of certain magical conceptions and of his practical experience as a herd-hunter. In the wall paintings, carvings and modeling in the caves of the upper Paleolithic Ages, immediately preceding the Neolithic and the Age of Domestication, man clearly demonstrated his knowledge of the reproductive processes and used these as a formula of sympathetic magic to encourage the increase of the herds and, hence, man's food supply. As an experienced hunter, he must have also noted the increased ferocity of the males during the mating season.

There must have been a first man to conceive the idea of castration, and not only the first kind of animal, but a first actual animal to be subjected to this experiment. Later,

we will consider the first beginning of man's experiments with steam and electricity and his present experiments with the cosmic forces in the atom. I submit, with all respect, that here we are dealing with an equally vital and philosophically similar experiment in power. How much this invention of castration added to the force of humanity in the conquest of nature or environment, how many millions of otherwise weary miles of travel, how many billions of tons of otherwise unbearable burdens, it has relieved man of, is beyond computation. What humanity owes to this minor surgical operation performed with a stone edge can never be estimated.

Castration was practiced among the herders and breeders of cattle, horses, camels, swine and reindeer. All these cultures touched at certain points and borrowed from each other. Types of harness, methods of driving, riding, milking, etc., are also evidently borrowed by one group from another. The diffusion of these culture traits are far too complex to permit of any such easy explanation as independent invention in each region. Asia and Eurasia, is an admittedly large area, but no part of it is inaccessible to wandering herders. For many reasons the ox seems to have been one of the oldest animals broken to draught, much more ancient than the horse, but perhaps the dog and the sled were older and the ox only the first draught animal broken to a wheeled vehicle. The dog was beyond question the first animal man domesticated and this may even have occurred while man was still a hunter. This fine, faithful companion followed a different pattern of domestication, since man never tamed it as a herd, since no man ever had the slightest use for a pack of wolves. Man had to break the wolf's natural pack loyalty before he could use him as a hunt-

ing companion. It is in the secondary domestication of other animals that man proves his greatest ingenuity.

Man has greatly changed the type, character, habits, form and weight of his animals. Food control and housing have influenced these changes, but the main force in this direction has been selective breeding in the interests of man, rather than of nature. The invention of castration, since it gave man control at least in the elimination of certain types of males, was a powerful factor in these matters. So far has this selection gone that there are many types of domestic animals today who could not exist for a single generation without the help of man, their master and modifier.

In time, as social habits grew more and more complex, and the demand for docile slaves arose, man applied the invention of castration to slaves. The eunuch became a regular form of merchandise. The Roman emperor, Domitian, not otherwise distinguished for his kindliness, once passed a law against the practice, but with the usual effects of laws passed contrary to the practical interest of big business. It may be a partial palliative for Italy's recent colonial venture in Africa if she stamps out this cruel custom in Abyssinia.

Outside of Asia and Eurasia, the list of domesticated animals is trivial. Egypt contributed the ass, the goose and, perhaps, some ducks. Peru contributed the llama, a wool-bearing draught animal, also used for food, and Mexico contributed the turkey. Asia's, and perhaps Eurasia's, list is magnificent. It includes the ox, the yak, the buffalo, sheep, swine, the elephant, the Bactrian Camel (ancestor within historic times of the Saharan camel), the domestic chicken, pigeons, certain ducks (from China) and the horse.

To account for this predominance of Asia in full is, of course, impossible. Perhaps it may be due to the greater antiquity of man in Asia or to the richness of adaptable fauna. It may be due to the invention of wheeled vehicles, or it may be the domestication of some single type of animal spread to other types, due to the fact that Asia offered greater opportunities for contacts between peoples than either the Americas or Africa and hence broader opportunities for diffusion. But the fact of Asia's richness in domesticated animals is on a par with her superiority in the number and character of her food plants and her technical inventions. Her great richness in vegetable forms must have had some bearing on the subject. This is, however, conjecture; we must remain satisfied with the facts without too definite an explanation.

We may now examine certain specific facts in this history: The reindeer is perhaps the last animal man domesticated. It is, of course, the tamed caribou; the same animal once hunted in France during the Magdalenian Age. Today, there are still wild caribou in boreal Europe, Asia and North America and these wild reindeer are still hunted.

Gudmund Hatt, the recognized authority on reindeer nomadism, has this to say on the matter:

"On the whole, the culture of the reindeer nomads contains a number of features which are evidently older than the domestication of reindeer, and many which have been inherited from a hunting period. A comparative study of the material culture of the reindeer nomads and that of reindeer hunting American tribes of northern Athabascan and Algonkian stock, would disclose a considerable number of fundamental similarities. In fact if these northern Indian tribes had adapted the reindeer

as a draught animal, they would have fitted remarkably well into the ensemble of reindeer nomads."

Curiously enough, the natives of boreal America, who borrowed so much from Siberia, did not borrow reindeer domestication, but remained satisfied with the sled and the dog for transportation. But they were great hunters of caribou and hunted them by the same organized methods once used in Europe and Asia. But with the introduction of modern whaling into the North, they over-hunted these herds and forced them to change their habits, with the result that the once countless herds were diminished to a dangerous degree, and their hunters faced with starvation.

But these Indians are now the wards of the United States and Canada and, fortunately, both of these nations remember the shameful history of the bison. The relations of these governments with their Neolithic charges, has not been particularly wise or kind. But in this instance, both governments have acted with rare good judgment. Reindeer have been imported and schools established to teach Athabascan Indians and Eskimos the art of domestication. Thus the status of a hunting people has been lifted to the more advanced status of herding in a single generation. One rather unforeseen result of this experiment has been the appearance on modest metropolitan menus of legal "venison," actually reindeer meat. After thousands of years, civilized man may enjoy again the favorite food of the upper Paleolithic Ages when the glaciers lay in sapphire walls across northern France.

For all we know, the last great free range of herders may be the barren hillsides of Alaska and the frozen tundras and scrub forests of arctic Canada, and the last

of herd animals, the reindeer. Noting this experiment, the United States may turn back and domesticate an animal which so far has eluded domestication, the bison. The wasteful slaughter of this noble and valuable animal was one of the great sins against common sense. The United States might turn back a few million acres of its dust bowl into buffalo grass and grazing bison herds. Buffalo rump steak is better than dust storms, and buffalo robes more desirable than flooded cities or silted rivers. Perhaps in this way an industrial people might "invent" a domestic animal of their own in the Age of Machinery.

Sheep are among the most ancient of herd domesticates and were never individually trained for economic services. Man used them first for food, then for both food and wool for textile purposes. In very ancient times there were many varieties, the result of different conditions of feeding, care and selective breeding. Yet practically all breeds, ancient and modern, are believed to have sprung from the Argali sheep of western Asia. Even in Neolithic times, sheep had spread from their original home into Mesopotamia, Egypt, the Mediterranean Islands, Italy, Central and Northern Europe, England and the Orkney Islands. Today there are thirty-two recognized breeds of sheep and innumerable crosses, and sheep have spread all over the world except in the far North and the moist tropics. Yet sheep are still herded in the most primitive manner in some parts of the world.

Dr. Max Hilzheimer in a recent issue of *Antiquity* says: "In large tracts of Asia, domestic sheep live in exactly the same way today, as in their wild state, so now they make annual migrations; the owners follow behind, and the sheep take them from summer grazing

to winter pasturage, and back again. They never became domesticated in the proper sense of the term, for they are never housed under a roof—in fact they are exactly like the tame reindeer. Following on the protection which man afforded them against animal foes, breeds became possible which otherwise could never have been evolved, such as the fleecy sheep, the fat rumped and broad tailed breeds; while these characteristics were preserved by man when they once appeared because they were of use to him."

Other animals, such as the sheep and the ox, may have been of greater economic value, but the horse stands first as a social factor in early history as the great force in migration and wars and has only recently been in part replaced by the motor. For thousands of years the horseman was the ruler of destiny. To the settled agricultural civilization of Asia Minor and Mesopotamia this strange and terrifying creature was known as the "ass of the mountain," and man looked always with fear to those defiles in the mountain which led down from the high plateau to the fertile and unguarded plains. In the 2nd millennium B. C., civilized Egypt recoiled in terror before the Semitic horsemen, the Shepherd Kings and the Hittite invaders. But later, her own soldiers and nobles adapted the horse and the two-wheeled chariot. The Greek nobles and their Roman imitators were horsemen, although the Greeks became men of the sea, "frogs squatting around the Mediterranean pond." But they had first ridden out of the northern plains on horses to conquer the older cultures of Mycenae. We still retain the word equestrian in our language as a synonym for the aristocrat, the "mounted man was once the soldier," the noble of Rome when Rome and the world were one. The knight

of the Middle Ages, mounted and armored, was the central and controlling military and social factor of those times. His great castles and invulnerable covering, and the resistless impact of his charge, only gave way to the invention of gunpowder in the 14th Century. For 5,000 years and more, the horse was master and all horseless men were at the mercy of the Riders of Fate.

Hilzheimer believes that all horses, with the possible exception of the Barb, are related to the now extinct species of the Tarpan which once wandered about the steppes of the Black Sea, a product of Eurasia (with the emphasis on Asia). There seems little relationship between the shaggy, scrubby ponies of the North and the noble chargers and chariot horses shown on Assyrian reliefs, or between the heavy Percherons and Clydesdales and their ancestors, the destriers of the feudal knights, or the lean and graceful hunters and racers of today and the spirited steeds shown in Egyptian paintings which were perhaps the ancestors of the famous Arab strain. Yet these differences are due to usage, to the genius of breeders, to climate and to food. No doubt a large part of the former superiority of the horses of Persia, Asia Minor and Africa, over those of Europe, rests upon the agricultural invention of cultivated horse fodder and that in this list, alfalfa plays no small part.

But however large a part the horse played in later civilization, however romantic and important a factor it was in early history, its first impact was detrimental to civilization. For thousands of years the sedentary, agricultural, civilized people trembled before the hordes of uncivilized horsemen pouring out of Asia. Again and again, these human waves of destruction swept over the nurtured fields leaving barrenness and misery where

there had been abundance and the ways of fruitful life. Damascus and Babylon, Ur of the Chaldees, Nineveh and Memphis knew the bitter dust of those thundering hooves. India was raped again and again, and even China's great wall was built in vain. The Scythians, who vastly troubled Herodotus, 450 B. C., and the Hiung-Nu, who threatened and looted China from time to time, seem strangely similar. Both lived on kumiss, both drank intoxicating beverages from the gilded skulls of their enemies. Both made sacrifices of white horses on hilltops to their gods. Both lived in the saddle and were famous archers. Rome, secure in her ancient rule, drew about her dignity the circle of her sturdy legions; but in spite of her forts upon the Danube, the Rhine and the Euphrates, at last she yielded to these endlessly flowing, eternally renewed streams of horsemen moving westward, ever westward, out of the arid plains of Asia.

Constantinople, guarded by her massive walls, her ships and the secret of that unquenchable fire she had borrowed from the Assyrians, kept the horsemen at bay for a fruitful thousand years after Rome had fallen and the rest of Europe had become one vast bivouac of tethered horses. But less than half a century before the mechanical genius of western Europe opened the oceans of the world to exploitation, this gracious mistress of the Bosporus fell before the leaguered horsemen of Mohamet Ali, aided, it is true, by the gunpowder and great cannons of the Franks, proving that even then the trade in munitions was international in character, and that neither race nor creed must interfere with business.

Consider the cities of old Europe which face the East: they are walled and buttressed, even their ancient churches are stout fortresses, armed against that mid-

night which forever threatened from the East. Only after America had been discovered, only after Peru and Mexico had been looted, after Europe had had its second birth of invention and of iron, did these restless waves pause at last before the walls of Vienna and recede before a bitter winter, gunpowder and cannon. The horse was once as potent a factor in war as the motor now promises to be.

Modern investigation is now revealing a Hither-Asia, far different from the hopeless deserts of our present knowledge. Over two hundred and fifty ruined cities have been marked upon the maps of archaeologists, each one graciously and piteously beckoning our largess to reveal its buried beauties to a world which, God knows, needs every smile of ancient loveliness to gild the grimness of the modern town. Good plumbing is beyond price, no question, but it is not necessarily a substitute for civic beauty. Each of these cities was once a center of wealth, built upon agriculture and commerce. Each was destroyed by war in which the horse was the dominant factor—greater even than iron. I do not blame the horse nor iron. Remember that when man invented domestic plants and animals, he also invented war. Nor was the evil done these cities entirely a matter of ancient times; nor, as we once unctuously believed, because of acts of God or so-called natural causes.

Professor D. S. Sanford, of Oxford, says: "I am convinced that in the Christian Era at any rate there have been exceedingly few real changes in climate, though there have been vitally important local changes. On every hand we see how man has reclaimed vast areas from the desert and let them decay." The same bitter truth applies to the once fertile fringe of Northern

Africa: man once made it fertile; war, not nature, turned it into deserts.

Agriculture in Persia, Babylonia and Chaldea depended upon vast irrigation projects—the control of the Euphrates and the Tigris and upon strong central governments who knew the value and the peril of water and who knew that civilization rested upon agriculture. Hills and forests were protected and erosion was controlled. No one had the "right" to do what he wanted to with essential natural wealth.

It is also said that the ancient invading armies, cruel as they were, and eager for plunder, respected the forests and the irrigation system even while destroying the growing crops. But since the Christian Era, or rather since the fall of Rome's authority, men ceased to respect the work of these old engineers, or the forests and water. Mohammedan raiders were horsemen, wild herders. To them this intricate system had no value. But it was the Crusaders who did the greatest damage. They knew no more of agriculture in its richer aspects than America's southern mountaineers know today. They lived on salt pork and beef and cabbage and on wheaten, rye and barley bread. They destroyed the forests, broke down the reservoirs and cut down the olive orchards to make war engines, catapults, moving towers and battering rams.

Today the descendants of Attila, the Hun, of the Golden Hordes of Genghis Khan, and the followers of Timur, that lame butcher, still wander about the chilly barren deserts of Higher Asia, herding, as of yesterday, sheep and camels and horses, addicted, as occasion rises, to a little modified banditry, but dreaming no more of world Empire, unless some modern nation, roused by the ghosts of the past, train them in the western technical methods

which once stopped these very maraudings. They will not, lacking such aid (which of course may be given), trouble such meagre peace as Europe or Asia knows.

Yet what have we done with all our power and science and need to cure the world of those terrible deserts which the greed and ignorance of man have made, where man once had created plenty and security from every other peril except war? Man's ingenuity in destroying his own good works is amazing, but it is not his chief charm. His ancient invention of war has tended to nullify many of his other inventions. Force has ruined many a civilization. Force, alone, has never reared one. There is no such thing as a physical civilization. There never can be. It is a contradiction in terms.

CHAPTER IX

EGYPT, SUMER, YUCATAN, PERU

GREAT civilizations, rich in dignity, jeweled with beauty, tranquil and secure, have been based upon the cultivation of cereal grains. These civilizations have had only a slight dependence upon domesticated animals, the metals, or the technical inventions growing out of the wheel. Civilization is, as it were, a second flowering of barley, wheat, rice and Indian corn. It was the cultivation of grain in favorable regions which first gave man security from hunger and caused him to cease his wanderings and fashion on his many tongues and in his myriad hearts a word for "home."

We think of Egypt as most ancient in days, and so, indeed, she is, the most venerable, continuous, political and economic association of men still existing on this earth of ours. Through wars, rebellions and invasions, this civilization has endured and, from time to time, has risen to great brilliance. But even Egypt is still less an cient than barley and wheat. Through the Greeks and others, Egypt's gifts have passed to the world. She is not without distinction.

The Egyptians, first of all peoples, divided the years into twelve months of thirty days each and with a terminal five day festival, making the 365 days of our year. This she accomplished in the year 4,241 B. C., thus introducing the earliest of all known human dates. Time was

a necessity to the Egyptians: they had to know when to expect the *Nile* floods and when to prepare for planting crops and how to measure and distribute the life-giving silt and water. They did not at first make allowances for the leap year, and thousands of years later, when they attempted to make this correction, the Ptolemaic Greeks had gone back to their lunar month and year, and would not make the change.

As early as 3,000 B. C., the Egyptians possessed a series of twenty-four alphabetic signs each representing only a letter. This was the earliest letter alphabet in the world. The Egyptian might have written his language with this phonetic alphabet, but his sign-group writing habit was too much for him. Conservatism is a great force in culture, but it works in both directions.

To Egypt we owe the invention of ink made of vegetable gum, water and the soot of blackened pots. Our first pen was a split reed of the *Nile,* and our surface for writing and our word "paper" came from "papyrus," the peeled skin of a *Nile* stalk, glued into sheets. On the coast of Phoenicia was the town of Byblos where the merchandise of Egypt was to be purchased and bales of papyrus were for sale; and from here we take our word "Bible," or "The Book."

Not later than 1,600 B. C., the western Semites, near Egypt, had devised an alphabet for commercial purposes, based upon Egyptian hieroglyphics. The Phoenicians borrowed this convenient trade adjunct and lent it to the Greeks who added vowels. By 1,000 B. C., the Arameans borrowed the alphabet from the Phoenicians, and turned it into the earliest system of writing known which exclusively employed alphabetic signs. The Babylonian caravans carried this writing into western Asia and it

passed down the Euphrates into Persia and the Asiatic lands, so that even Sanskrit was copied from it.

From India, westward, every alphabet has descended from this Oriental alphabet which stems from the Egyptian idea of 2,000 years earlier. Aramean was the language of daily occasions and of commerce, in the ancient world of Hither Asia, and the language in which Christ spoke from the Mount of Olives.

To Egypt the world owes the idea of the sailing ship which remained, in basic principle, unchanged from at least the 3rd millennium B. C., until western Europe thrust forth into the turbulent Atlantic in the 14th and 15th centuries or 4,500 years later. To the *Nile* craftsmen we owe our furniture They had to import the wood, since the *Nile* valley had none worthy of their skill; they had to import copper for their tools, since there were no mines in Egypt. But they gave the world, through the Greeks and others, beds and couches, chairs (stools, folding and plain), and thrones. Wherever people sit down, they are paying, unknowingly, a compliment to *Nile* cabinet makers and to the gracious sense of dignity of old Egypt. To this there is only one slight exception. In ancient Peru and the Mayan Empire, stone carvers had converted the animal forms of metates or corn grinders, into thrones for the ruler whose magical arts produced the crops of Indian corn.

Egypt has left us the most ancient records of trade. More than 3,000 years before Christ, she had sailed up the *Nile,* fortifying the cataracts against the Nubians, marched into the Sahara and left an armed company in an oasis to keep the Libyans in check, and established trade in ivory and gold dust, ebony and black pigmy slaves to delight the gracious court of the Pharaohs.

The *Nile* was connected with the Red Sea by a canal. The ships of the Pharaohs knew the east African coast as the Land of Punt. Here they sought gold and ivory and Negro slaves. The intricate Cult of the Dead needed precious essence, myrrh and storax. Those who had been the mighty of the earth had to be preserved in all their splendor when death removed them. Theirs had been the fancied power to make the *Nile* flood in fertile deposits of mud; theirs had been the virtue which made the narrow ribbons of soil between the *Nile* banks and desert cliffs, the most fertile acres on earth. Egypt invented the first nation of which we have any record, that is, the first group of people living under common social conditions with a common language, body of laws and religion. She created the first empire—a group of nations held in a social pattern by military authority.

All these things Egypt accomplished with no metal other than copper, which she imported from her mines in Sinai. The only iron she knew came from meteorites and was called "Metal of the Gods" or as a minute by-product of the golden sands of Nubia. This her priests used to open the sealed lips of her dead in order that they might eat the food left in the tombs. Her only native beast of burden was the ass. The ox was used largely for ceremonial purposes and for milk and meat and Egypt had no wheel nor any name for a wheel.

The horse, smelted iron, the bow and arrow and wheeled chariots, all came into Egypt around 1,800 B. C., introduced by the northern invasion of the Hittites, the Shepherd Kings, almost 3,000 years after Egypt had invented civilization. But even the grains of wheat and barley upon which her civilization rested, even the wood for ship-building and furniture, and her sheep and cattle

and her copper and the potter's wheel, flax and her early loom were all introduced into the valley of the *Nile*. Egypt is the oldest land still civilized, but she is not the home of the factors upon which civilization is built. She was simply an environment, peculiarly hospitable to the development of these factors.

The ancient land of Sumer, between the *Euphrates* and the *Tigris,* Land of Two Rivers, was once a vast and fertile oasis reaching in later centuries from the Persian Gulf almost to the Mediterranean Sea. As early as the 3rd, perhaps the 4th, millennium, B. C., Sumer had learned to control the floods of her turbulent rivers, how to store surplus waters and develop irrigation. What is now a vast and terrible desert (made by war) was once waving fields of grain and flowering orchards of fruit of the vine and the olive. Two thousand years before Egypt, Sumer knew both the wheeled-wagon for transport, and the chariot of war drawn by oxen and the native *dziggetaie,* an animal midway between the ass and the horse. She has left us carven pictures of her wagons, her chariots and her plows, and also of an armored and helmeted company of spearmen which later became the Greek phalanx, the Roman Legion, and our own regiment. Her early tombs of sun-baked and fired brick show that she knew the trick of the arch and the dome and column, later to be the glory of Mediterranean architecture. We divide our minute into sixty seconds and our hour into sixty minutes because that was the way her merchants counted. Her sun-baked bricks impressed with the wedge-like puncture of a pointed reed were the first commercial contracts and bills of exchange, and her carven seals, pressed on the bindings of her bales and sacks, are the

first commercial signatures. Her mina, shekel and talent (once measures of weights) became, in later times, coined money, the ancestor of *liras* and *livres,* pounds and dollars. One of her late Semitic conquerors, Hammurabi I (2,200 B. C.), gathered the laws of his land together in one code and carved this code upon enduring diorite that all men might read and know the Law and today a few gifted scholars may still learn the mercy of the King. This is among the oldest codes of law—the first time that men could read the law under which they were supposed to live.

In the University of Pennsylvania Museum is a bust of Queen Shub-ad. The restoration has been made with due scientific fidelity and great spirit. The mass of black hair is crowned with wreaths of golden leaves and flowers; the lovely throat encircled with necklaces of lapis lazuli and golden beads. The regal lady used cosmetics with no little effect. Preserved as she is, through a devoted and appreciative modern science, she is an utterly ravishing and a most sophisticated survival of a rich civilization. She is more regal and of more appealing charm than the robust princesses of German extraction who flit in and out of our Sunday supplements.

In her tomb were discovered vessels of gold and silver to fill with sinful lust the collector's simple heart, and arouse the envy of modern smiths. There were also modeled heads of silver cows, proving the high state of the sculptor's art at that time.

But there were also other matters perhaps not so much to our liking. As a living princess, she had been properly attended, so neither in death was she left alone. Here in this grim tomb, for thousands of years, have lain the bodies of her ladies-in-waiting and, at her head and

feet, kneels a special favorite as for a court ceremony; and also her harpist, the still arm and hand that once awoke the soothing chords, now resting all silent above the silent harp, concerned no more with courts or queens.

Nor were the kings less well attended when they had done with matters of earthly pomp and administration. They, too, departed in the style to which they had been accustomed. Companies of their guards, still clad in helmets and cuirasses of copper, still with their spears, await the pleasure of departed majesty. And beside the wagons are the bones of the patient oxen (three to a wagon), and in the wagons the bones of the drivers and beside the oxen, the bones of the grooms. Nor were lighter matters forgotten. In this same tomb are the bodies of nine ladies of the court with golden wreaths about their once lovely heads. All very shocking to us, who kill with industrial machines and pleasure automobiles in the United States alone some 36,000 people each year and 16,000 pedestrians who get in the way of progress. But bear this in mind: royalty in Sumer were gods. They guaranteed the crops, controlled the waters, and made the flocks multiply, and barley and wheat to grow. This, all men could see for themselves; and this all men, including the kings and queens, most firmly believed. To doubt such obvious truths was to offend the ultimate gods. And the priests saw to it that heresy did not pay dividends.

Today the half-dozen kings, still flitting ghost-like about Europe, could not, if they pooled their efforts, raise a summer rain shower or a head of cabbage. And this, also, is painfully apparent to all men, including the kings. Consequently, human sacrifices are no longer a part of any royal funeral. Royalty costs enough as it is.

It is neither the kings nor the undertakers who have changed: it is the times.

Our objection to human sacrifice, in view of our disregard for human life, in war and other phases of preventable accidents, would have seemed strange to the rulers of ancient Sumer. But they would have been more horrified at our lack of control over the *Mississippi* and its affluents, the *Indus* and the *Yellow Sorrow* of Old China. They controlled the *Tigris* and the *Euphrates,* as their royal brothers controlled the *Nile.* They might have said, not without truth, that no civilization can be a great civilization, nor last for thousands, rather than hundreds, of years, unless it gains control over its rivers.

CHAPTER X

THE NEW WORLD ASPIRES

UNLIKE Asia, so rich in cereals, America produced only one domesticated grass seed, Indian corn, or maize. This may have been due to a lack of wild species suitable for domestication. It may also be a kind of measure of the antiquity of agriculture, and also of man, in the New as compared to the Old World. This extremely useful food plant had a wide distribution in pre-Colombian America and, at later times, all over the world. But for the moment the point of interest for us lies in the fact that the origin of maize corresponds (as it should) with the origin of the highest centers of civilization in the New World.

The most generally accepted belief is that maize and cotton originated in southern Mexico and that the wild teosinte weed is the ancestor of corn or maize and that the original cotton of America comes from the same general region. Recently, this theory has been doubted, and Peru suggested as a possible home for both corn and cotton. The high attainments of Peru in agriculture, the arts, engineering and social organization entitle these claims to the most serious consideration. But these are only matters to disturb scientific teapots of modern anthropology.

There is no dispute that the highest American culture was reached in the coastal valleys and Andean plateau of Peru, in the Mayan area of Yucatan and in southern Mexico. Among Americanists, at least, no one questions

that, in these regions, culture reached the status of civilization. If we take the contiguous land area from Utah, the old southwest of the United States, parts of Mexico and central America, and the Pacific coast, west of the Andean ridge, we will find within this ample area certain common technical factors such as maize, cotton, the use of tobacco, similar methods of pottery-making and decoration, stone-building and carving, cotton-spinning, the two-barred loom, and also a strong resemblance in certain cosmic myths and at least the beginnings of interregional trade. It is all one technical complex with greater or lesser proficiencies in the various areas and in various inventions. Surely within areas so accessible, we must accept the diffusion of ideas from central and single points of origin. In certain areas, necessity, opportunity and genius, and perhaps greater time periods and greater isolation, permitted, if not encouraged, a higher development in certain directions. But for our purposes, we are dealing with a general region of culture, in two areas of which, civilization reached a very high level, comparable (within opportunity) to either Mesopotamia or the valley of the *Nile.*

The Mayan Empire of Yucatan—that vanished civilization now rising resplendent out of the jungle under the reverent and inspired guidance of the Carnegie Foundation—possessed no domesticated animal except the turkey, unless we place human slaves in this category. The only metals it knew were gold and silver and copper, and these were used largely for ornaments; and towards the last of its history, a little bronze which had come by trade from Peru. Its principal raw material for tools and weapons was stone-flint, chert, quartz and obsidian. As in all the rest of the Americas, the wheel, in any form,

was unknown until introduced in the 16th Century by Europeans who had received it from Asia 2,000 years earlier but had improved upon this intrusion.

Yet the Mayans produced a gracious and a beautiful architecture, even if lacking in the dome and arch (known to the Sumerians, and copied by better Mediterranean cultures). They also built graded roads of stone running straight between their cities. They had a trade beyond their own borders in cocoa, cotton-mantles, beans, tobacco, obsidian and flint-blades, copper, gold, feathers and human slaves. In the 14th Century A. D., they were better mathematicians and more observant and accurate astronomers than the Europeans of that day. They had a beautiful system of hieroglyphics not yet wholly intelligible to us, made paper or papyrus and books which the Spanish priests burned with considerable enthusiasm. Their pottery, gold and silver work and carved alabaster vases and obsidian masks, and jadeite figures, place them on a level with the Egyptians and Sumerians, in spite of the curious academic prejudice which still places their arts in ethnological rather than fine art collections. Fabrics that have been retrieved from the silt of their sacred pool or spring at Chichen Itza and dry caves indicate a considerable technical knowledge of fabric construction, not so intricate nor so beautiful, as that of Peru, but rather above than below the Egyptian standards before the Christian era and later Asiatic intrusions.

With the exception of their hieroglyphics and paper, there are no technical factors in their culture which rise above the earlier or lower phases of the Neolithic Age. Yet this academic measure of culture fails before their

actual cultural achievements. They had developed an orderly, fruitful and disciplined plan of living. There was dignity, pageantry, gaiety and charm in their lives. They had a great literature and a great philosophy. If civilization means anything beyond an unsupported assumption of superiority of western Europeans' mechanical culture, then they were civilized, even if they lacked wheeled-carts, iron and steel, gunpowder, the navigator's compass and the printing press.

In justice, however, I may not omit this fact: We owe some of our knowledge of their fabrics to the judicious use of a modern steam shovel in the sacred cenote of Chichen Itza. The Spanish priests had come upon a legend of human sacrifice performed, not without dramatic effects, over this well, as late as the 12th Century of our era, and our scientists decided to test this legend in the 20th Century manner. The Mayan idea seems to have been that the ceremonial burning of dedicated virgins would induce seasonable showers of rain for the corn fields. Fortunately, the idea was not tried out in the famous dust bowl of the United States during the last few summers, though it might of course have worked as well as some other suggested cures. This excavation produced many lovely ornaments of jadeite and gold, and a considerable number of fragments of cotton cloth not lacking in technical interest. The ones which I have examined and the few fragments in my own collection have been charred by fire. This fact may prove the existence of human sacrifice and, indeed, there is no doubt of this grim fact. But, fortunately for us, civilization is not judged by its crimes and mistakes, nor its cruelties, but by its achievements.

There are as yet no positive dates either for Peruvian civilization or for the amazing cultures of Paracas Tiahuanaco, Pachacamac, Nazca, Ica, Chan-Chan or Chimu, and other City-States of which Peru was composed. Nor are we too certain as to origins of the racial factors of which these civilizations were composed. Each of these culture zones has distinct and recognizable artistic characteristics and each lays special emphasis on some technical trait. Yet all are linked in one general technical pattern and all of them are united in one general social system.

No doubt Peru borrowed certain ideas such as corn, cotton, cosmic myths and certain forms of art from the North. We have seen that Egypt and Sumer also entertained and elaborated intrusive ideas; on the other hand, the white potato, the tomato, the domesticated llama, bronze, quinine and coca (a narcotic) and the peanut were her own. Important as original ideas may be to cultures in general, civilization depends rather upon the development of ideas than upon their origin. Technical ideas either in number or variety are not the full measure of civilization. Egypt and Neolithic Europe were about on a level so far as inventions were concerned. It is even probable that Europe knew the wheel and the horse and bronze before Egypt. But a cultural comparison between the two civilizations is impossible.

Today, the United States and England possess a greater variety of mechanical ideas, infinitely greater wealth and physical power, know more chemistry and physics than either Gothic France or the Age of Pericles. Yet it would take a rather robust faith in modern progress to place our present civilization ahead of theirs.

Peru's work in the precious metals, ceramics and ar-

chitecture place her among the great artistic nations of antiquity. In her chosen arts of the loom, she stands superior among all nations and all times. Her nearest rival, Sassanian Persia, lacks in the perfection and variety of her methods of expressions if in nothing else. To this delightful controversy, I shall return with zest in due season.

But Peru's greatest contribution to civilization was a social system which, for thousands of years, had banished want or the fear of want, the memory or the consciousness of want from the minds of men.

Nature had presented her with the opportunities of fertile valley soils and endless days of sunshine, but had denied her rain. Her only source of water was the melting snows and ice of the Andean rampart which separated her from the moist jungles and the rain clouds and which drift across these jungles from the Atlantic. Peru, save for the genius and the patience of man, must have remained forever one of earth's most perfect deserts.

Her civilization, her very life, depended upon the control of the Spring-time torrents of her rivers rushing from the mountain tops to the Pacific Ocean in a welter of foams and a waste of water. She built great reservoirs of masonry, long aqueducts of cut-stone, winding in and out of her hills and valleys for hundreds of miles, and a labyrinth of irrigation ditches. In some seasons there were floods, when too much snow melted; in others, there was too little snow or too slight a melting. So Peru stored her surplus water and thus adjusted the vagaries of Nature to her practical needs. Nature was all right, but needed a little organization to back her up. Organization is but another name for preserved genius.

She built great palaces for her rulers and vast temples

for her gods, but these were also storehouses for her surplus crops of corn and cotton, wool, peanuts, potatoes, gold, silver, copper and tin. She knew that the seven lean years must follow the seven fat ones. She prepared in time. She did not destroy her plenty—she saved it. Thus she built walls of prudent plenty which want could not scale nor famine undermine.

There were no rents, no mortgages, no profits nor speculations. Corn and potatoes were for hungry bellies; wool and cotton to clothe naked backs. No man owned land, yet no man could be dispossessed from the use of land. When a man or woman was fifty years old, younger people had to cultivate their lands for them. There were the soldiers to defend the land and for conquest, and officials to measure the waters and apportion the land to see that crops were planted and tended and that none were idle and that no man took by force the rights of any other. There were, of necessity, taxes to support the administrators and the soldiers.

It is difficult for us to understand the Peruvians' measure of values and economic philosophy. It is equally dangerous to apply modern terms such as "socialism" or "communism" to a technique of living developed centuries before any such philosophies arose. These peoples have left us no written language and hence we must rely upon traditions repeated to the Spaniards and upon certain observations made by the Spaniards. To these we may add the undisputed evidences of archaeological research.

There were ruling priestly classes—a carefully graduated scale of classes in fact. The rulers, the nobles and the priests had the best of all things and in proportion to their rank. But no one was denied access to land, to

water, to seeds for planting, nor a share in the harvests in proportion to rank and need. Provision was made for the aged and the young, for those engaged in public service, such as care of the irrigation ditches, warehouse attendants, for the minor priests and soldiers. No one could buy, sell or own land. None could be denied the fruits of the land and everyone of proper age and in good health had to work at the tasks set.

But the rulers had their duties as well as their privileges. There was the care of established irrigation systems and the planning and building of new ones. These were by no means haphazard affairs. Some class in Peru must have been good engineers. The ruling class had to know the kinds of plants for the various areas and how to distribute the products of the various regions to fit the wants of the different parts of the Empire. Someone had to see to the storage of the surpluses, to guard against the years of leanness. This required no little accounting and much personal inspection.

But these practical duties were, no doubt, less important to the lower classes than the relationship between the ruling classes and the Gods. They were the children of the Sun and Moon. They also represented the people before the Gods and everyone knew that the Gods liked well-dressed people to perform the essential ceremonies. So they willingly bestowed gold and silver and fine garments of the soft wool of vicuna, dyed in rich shades, upon their rulers so that the Gods might be gracious to the nation. Besides, the people themselves enjoyed the pageant and did not grudge the cost of the finery any more than the average Englishman begrudges the price paid for a Coronation.

Our ideas of gold would have vastly confused these

simple people. Why should anyone be at such vast pains to dig gold out of the bowels of the earth or wash it from the streams, and then build, at great expense, vaults in the ground and bury it out of sight? If this was the ultimate purpose, why not leave it alone in the first place? Gold was the symbol of the sun's beauty: obviously, it was meant for rulers and to be admired by the world. Silver represented the moon, its only value lay in being seen.

Water, land, warehouses, roads, rulers and priests, were knit together in one pattern of plenty. The grim wolf who has gnawed the bones of the world for eons, and who still hovers in China and in India, in spite of ancient cultures and in spite of the white man's burden, could not huff and puff and blow the Peruvian house down. "Why disturb a system that worked so well?"

Peru knew neither iron, the wheel, the horse nor the ox, neither paper nor writing. None of these things were hers. She knew only a sober abundance and a beauty that still charms us from her thousand graves. We do not know the date when she began to work this modest miracle. But the date which marks her end and the end of her system, is as much a part of European as of Peruvian history. In the year 1532, Francisco Pizarro, an illiterate swine herder from Estramadura, and 150 iron-clad horsemen swept like a wave of flame across this devoted land. And men ceased to dream the dreams they had learned from the legend of the gentle Veracocha who arose from the foam of Lake Titicaca to teach them the arts and the most gracious art of living in tender kindness with each other. In this legend, he descended into the sea promising to return as a bearded white man from the East to bring with him an era of peace and kindness to all men. When

the Spaniards landed, the Peruvians believed that this promise had been redeemed and fell upon the sand to worship the god of their hopes renewed. They were swiftly disillusioned.

In an ancient grave in Paracas, in southern Peru, there was recently found a shawl of rare beauty and of great technical interest. The center is brocade of colored wool on a cotton background and the design is of conventionalized human heads. The border is composed of needle-crocheted, overlapping figures of symbolical scenes from their rich mythology, inexplicable to us save in its perfect beauty. This shawl, one of the earth's most exciting textiles, and among woman's greatest works of art, was found wrapped around the mummy of an undersized middle-aged priest, evidently once a man of power, distinction and repute. With him were entombed the mummies of five infants, quite obviously a sacrifice demanded by the occasion. Man, even at his best, has his bad moments.

CHAPTER XI

STRENGTH FROM THE HILLS

ONE of the oldest of written records is a Sumerian hymn dated about 4,000 B. C. and assumed to refer to the primitive inhabitants of the Euphrates delta when the conquering Sumerians first appeared. I give Leonard Woolley's translation: "Mankind when created, did not know of bread for eating or garments for wearing. The people walked with limbs upon the ground; they ate herbs with their mouths like sheep; they drank dish water."

It is curious how all conquerors, colonizers, invaders and uplifters feel under some strange obligation to impeach the character of their victims. The facts of the matter are that the people the Sumerians found in the marches of the Euphrates were far above the level suggested by this hymn, were little, if any, below the material culture level of the Sumerians themselves.

They made reed huts and daubed them with mud which dried in the sun—a sort of concrete construction with a frame of wood. These houses were built upon mounds above the floods, and stones were imported to support the pegs on which the wooden doors turned. They kept sheep, swine, goats and cows; raised barley and ground it in querns or circular grinders; had painted pottery, and floated about on the streams and lakes on balsas or pointed rafts fashioned from reeds. While their principal tools were of stone, imported from the surface of

the desert, they also had some copper. There is nothing "primitive" about this list.

In his *The Origin of Cultivated Plants,* Professor N. I. Vavilov (Leningrad, 1926) has offered a rather more satisfactory scientific approach to explain the dawn of civilization. He believes that the origin of cultivated plants should be sought in those areas which contain the largest number of the wild ancestors of these plants. Botany may thus help the solution of problems beyond the reach of either history or prehistory. Vavilov says:

". . . When reflecting on the process of the development of agriculture, we must needs recognize, that the period of great cultures, uniting populations made up of many tribes, was preceded by another period when separate tribes and small groups of populations led an isolated life in sheltered mountainous districts. The taming and conquest of great rivers, as the Nile, the Tigris, the Euphrates and others, required an iron and despotic organization building dikes, regulating overflowing waters, in a word, organized public works which the primitive agriculturist of Northern Africa and South-Western Asia could not dream of. It is very probable, therefore, that mountainous districts, being the centers of varietal diversity, were also the home of primeval agriculture. In these districts it is easy to use water for irrigation. Mountain streams can be easily led off and made to flow over fields. Not unfrequently cultivation is possible without irrigation due to abundant rainfall in these high mountainous zones. In agricultural districts of Mountainous Bokara, in Badakshan, various primitive stages of agricultural evolution can be observed, preserved unchanged during ages and illustrating different phases of agriculture.

"The differentiation of races and cultivated plants was undoubtedly favoured by variegated ethnic composition of the mountainous districts of South-Western Asia and Northern Africa. The ethnographical maps of the Caucasus, mountainous Turkestan, Afghanistan, Abyssinia, Bokhara, Northern India, represent the diversity of cultivated plants in these regions. The above mentioned mountainous districts are not only centres of the diversity of cultivated plants but also of the diversity of the races of man."

Vavilov recognized five, with a possible six, main centers of diffusion for the world's major crops, as follows:

(*1*) *South Western Asia*

Soft and club wheats, rye, small seed flax, small grained peas, lentils, horse beans, chick peas, a series of vegetable plants and Asiatic cotton G. herbaceous, C. G. Arboretum L., etc.

(*2*) *South Eastern Asia, mountainous China, Japan, Nepal, etc.*

Naked oats, hull-less barley, millet, soy beans—many cultivated cruciferae and a series of fruit trees.

(*3*) *The Mediterranean Center—North Africa (Egypt, Algeria, Tunis) Palestine and Syria, Greece, Spain, Italy, Western and South Western Asia Minor*

Durum wheat (whole group with 28 chromosomes) oat species (avena Byzantine) large seeded flax, large grained peas, vetchlings, horse beans, lentils, beet-root (sugar beet) and many vegetable plants and fruit trees.

(*4*) *Northern Africa, Abyssinia with the adjacent mountain regions*

Hulled barley, violet grained wheat, original races of peas, peculiar races of oats and by a series of cultivation, endemic plants.

(*5*) *The World—Mexico and Peru with adjoining mountainous countries*

Potatoes (white), Jerusalem artichoke, maize, beans, tobacco, sunflower and American cotton.

Professor Vavilov goes on to say: "Very likely it is still necessary also to separate the sixth island centers in the Philippine and adjoining islands, where several endemic species, and many original varieties of rice, coir, etc., are found. This center is not yet sufficiently studied."

And further: "The diversity of conditions, ranging from desert to oasis, and from soils devoid of humus, to soils of the Alpine and sub-Alpine zones, rich in this substance, have favored the origin and the concentration in these countries of an exceptional specific diversity of vegetation.

"Of the whole terrestrian globe, these mountain regions of Asia and Africa are up to now the most populated places. This feature was still more prominent in the remote past. Over a half of the human population of the world (900,000,000) is up to now concentrated in this mountainous zone (approximately occupying about one-twentieth of the whole area of land in the Old and New World)."

Assuming the correctness of Vavilov's brilliant syn-

thesis, it would seem that groups of people concentrating in the seclusion of highland areas, and taking advantage of an equal concentration of plants, long ages before the dawn of historically visible culture, evolved agricultural societies based upon cereal grains. These societies, because of the abundance and security of their food supplies, prospered and increased and ultimately spread beyond their original boundaries.

At first this overflow was in small groups, but soon such movements must have been in the nature of organized social and military movements. The necessity for social organization is obviously a result of agricultural necessities. Hence, the peoples destined to become Egyptians, Sumerians, Mayans and Peruvians, in fact, any of the ancient civilizations, came into the regions of their final development already more than half civilized. The nature, extent and duration of their civilization depended upon the opportunities in their new environments, their own genius, the character of the intrusions, and outside pressure to which they were subjected.

CHAPTER XII

I BREAKFAST WITH DESTINY

ALL history, that is, true history, was once life, so history should prove itself again in life. Let us consider these matters as they affect a breakfast table, my own by preference.

When I get out of bed, I have paid Egypt a compliment in two respects: In the first place, the idea of a bed was first conceived by a *Nile* craftsman; secondly, Time was an invention of an Egyptian mathematician. My sheets, being of cotton, I can date at least at 3,000 B. C. by a fragment of cotton cloth recently found in the ruin city of Mojendo-Daro in the Indus Valley. Ram's head seals and a lamb stew found in a covered earthen pot discovered in Tel Asmar in Asia Minor, imply a date for wool at least a thousand years earlier and add a distinction to my blanket. And as I dress, I reflect that my tailored suit was sewn with a needle, which invention belongs to the last Age of Ice in Europe, or thirty or forty thousand years ago.

I begin to feel a little ancient before I take my orange juice. We derive our word *orange* from the Persian auranja. I suspect my immediate ancestors learned about oranges in one of those looting expeditions we refer to as The Crusades. But the word is still more ancient. Naranja is Sanskrit, the Indo-European mother of all European languages, from the Greeks to native Jersey.

But I drink this philological juice out of a glass.

Beads of glass have been found in Egypt dated by the learned, *circa,* 3,500 B. C., moulded glass rather less ancient, 1,500 B. C., and blown glass in Syria at about the dawn of our era.

It is written that Septimus Severus, Emperor of the Romans, and of Lybian birth, visiting his loyal city of Alexandria, saw with great satisfaction the prosperous glass industry of that city. Like all rulers, he was anxious to encourage industry and promote commerce. So he put a stiff tax on glass and, with the proceeds, built baths for the people of Rome. And by this simple act of justice, turned glass vessels of all kinds into a luxury which all people would be anxious to possess. Luxuries, of course, should be taxed. The science of Government is less difficult than is generally believed by the uninitiated.

While admiring the justice of the worthy Severus, I have been sitting upon a chair and thus, somewhat indirectly, paying Egypt another compliment. This particular chair chances to be what is known as an "American Empire" and was made in about 1820, copied from a "French Empire" of a previous decade. The Parisian cabinet-maker got his idea from some bronze chairs made in Egypt three or four thousand years ago and looted from the Pyramids by Napoleon Bonaparte in the latter part of the 18th Century.

I like oatmeal, not because I have a Scotch name, but because I like oatmeal. But oats are not Scottish. Vavilov has placed their origin in the Chinese highlands. They came to Scotland either with late bronze or early iron. Now the habits of the Scots in regard to other people's sheep made their own highlands attractive residences and oats grow on mountain tops better than other grains.

China was also the home from which my dish came.

But here the matter is a trifle more involved. China received in the Han times (20 B. C. to 220 A. D.), from Arabia, a substance related to glass, known as glaze, which Arabia originally got from Egypt. In the Near East this glaze resulted in the famous Murrine Ware which delighted the fashionable Mediterranean world and led to a rather dull poem by Propertius (49 B. C.), in which a procuress offers a slightly reluctant, yet wholly desirable maiden the wealth of the Orient, "purple robes, silk dresses from the Island of Cos, and Murrine goblets baked in Parthian furnaces," as a reward for complaisance.

At first, China created substantial, wheel-turned vases, coated with Arabian glaze, but a few hundred years later, produced "porcelain." The Portuguese brought "china" or "porcelain" back to Europe in the 16th Century, and today it can be bought, of a kind, in five-and-ten-cent stores; and no procuress, in her right mind, would ever consider offering it to anyone.

If I have toast, the hard wheat once came from Abyssinia and the soft from Afghanistan. If an egg is added (which seldom occurs), I owe it to a bird known to the Greeks as the Persian Fowl, but, in reality, the Gallus Indicus, the jungle cock, which India domesticated before there were Greeks or Persians.

Coffee was once a wild bean in Abyssinia. In the 14th Century, it passed over to Arabia and was met with a theological blast almost as violent as that with which, in a later century, King James and the Japanese Shogun received the gracious Lady Nicotine. So the Civil governors, anxious to support the men of religion, passed stern laws against it and also collected baksheesh, or whatever was the synonym for graft in 14th Century

Arabia. The Dutch, finding it so well established in Arabia (Mocha), took it to Java, where the worm ate it, and, ultimately, to Brazil and Central America.

During the years of our recent economic chastisement, the Brazilian economists conceived some truly inspiring ideas about this soothing and stimulating narcotic. They burned this once Abyssinian berry under the boilers of Amazon steamers in order to let these steamers collect more coffee to burn under the boilers, in order to collect more coffee, etc. This is a confused explanation, but so were the minds of the economists.

Statistically stated, it worked out about this way: In 1928–1929 the United States paid about $300,000,000 for 1,400,000,000 pounds of coffee. In 1931–1932 she paid only $130,000,000 for about 1,500,000,000 pounds of the same kind of berries, but not (alas) the same kind of dollars. As a confirmed coffee drinker, I have some difficulty in determining which dates represent Hard Times.

I take sugar in my coffee. Herodotus (450 B. C.) refers to sugar as honey made without the aid of bees. The Chinese called it stone honey since they received it from the Persians in hard brown lumps. In the *Periplus of the Erythraean Sea,* circle of the Red Sea, first trade treatise in a European language (it was written in Greek about A. D. 60) it is referred to as "honey from the reed saccharina."

The Arabs brought the sugar cane from southeastern Asia to Syria and Palestine and ultimately to the once Fortunate Islands of the ancients, now known as the Canaries, and with it imported Negro slaves to tend the cauldrons. Here the Portuguese in the 15th Century found and approved of both slaves and sugar-making and, taking advantage of the Pope's slight geographical

error, imported sugar cane, sugar-making and slaves to their new colony of Brazil in the 16th Century.

From here it spread to the French, Dutch and English islands and the sugar planters became the *nouveau riche* of the 17th Century. The supplying of the sugar plantation with Negro slaves from Africa became a most important and profitable trade of that century. Land in these islands became too valuable for anything but the growing of sugar and food for the slaves had to be imported. America's early colonists in New England, New York and Pennsylvania fed these natives with Indian corn, salt fish, pork and beef and supplied them with staves to make casks, horses, knock-down houses and even small sailing vessels. In exchange they received tropical products such as cotton, molasses and rare woods and from the Spanish Islands, in particular, silver in bullion and coin. These various forms of wealth, together with bills of exchange the islands had received for sugar shipments were used by the Colonists to balance their merchandise accounts with England.

The Navigation Laws ordered that all Colonial goods should land in England and pay excise duties before shipment to foreign ports. Hence the Colonial trade was illegal since it was conducted directly between the islands and the Colonists and foreign nations in Europe. When England began to enforce the Navigation Law, the Colonists resented this interference with their commerce. Hence, the American Revolution may be said to be a by-product of the sugar and slave trades.

Most of the sugar of the United States comes from *Beta Vulgaris* (sugar beets) now grown in the west by irrigation from the melting glaciers of the Rockies. In 1873, during a chronic panic, the Mormon Church bor-

rowed $300,000 and built a beet sugar refinery and it is still a large factor in the sugar trade. Candolle places sugar beets near the Caspian Sea and dates them about the 4th Century B. C.

By this time, I am ready for my final treat. I open my newspaper, at which I have been taking furtive glances. Here, at last, I am in the Modern Age. Earnest men, backed by every device of science, have gathered, collected and dispatched, edited and printed for me every horror, terror and scandal from all over the world, and brought it to my door for a few pennies. Here is democracy, the free press, the power of the Fourth Estate, to lure me from my quests into the ages. But paper is Chinese (105 A. D.), and movable, cast-metal type was invented and used in Korea a hundred years before Caxton or Gutenberg!

With humble satisfaction, I light my cigarette—name and narcotic herb are both alike American, pre-European. But the paper is, as I have said, of Chinese origin. I am glad at least that I did not become too nationally minded before I had my breakfast.

CHAPTER XIII

CHINA AND PERSIA

UNTIL the Portuguese navigators in the 16th Century opened ocean trade with the Far East, the caravan routes across Higher Asia were earth's great culture roads. Thanks largely to the Chinese records and to European and American scholars who have translated and clarified these accounts, we have an accurate picture of these fruitful exchanges from the 2nd Century, B. C., down to the end of the Mongol reign in the 13th Century, when the Ming Dynasty closed China and Mongolia to the trade of Persia, the Near East and Europe; in other words, until China developed nationalism.

In order to get a clear picture of this ancient trade, we must bear in mind the fact that China already knew something of Europe through her trade with Java and Ceylon, where her merchants met the daring Moorish traders from Arabia. She imported gum storax from the land of Punt, rhinoceros horns, African ivory, the glaze for her first venture in porcelain, and many other things. She had heard of Spain and believed the merino sheep to be seven feet high and knew Spain had fine melons. China knew of the Mediterranean and the Atlantic. China had also heard of the great Portuguese ships then trading on the western coast of Africa which were later to circumnavigate the globe. Arabia she called "Land of the Western Sun" from "whence all good things come." China knew more about Europe or the West than Europe

was to know about China for more than a thousand years.

And she wanted to learn more. When her generals and commercial explorers arrived overland at the Persian Gulf, they desired to sail on to Rome. But the Persians were business men, with no idea of losing their profits as middlemen. So they told the credulous Chinese that the journey to Rome took two to three years and was very dangerous. As every good Chinaman wanted to be buried within the border of the Celestial Empire, a voyage of such danger cooled their desire for geographic knowledge. Actually, such a journey took about three months and men had been taking it for two, perhaps three, thousand years.

The exchanges between China and the West were among the most fruitful of all culture contacts and in these exchanges, China was by no means the loser.

At a remote period, she had received from the West the chariot wheel and its variants, the potters' wheel and the spinning wheel; and had evolved the silk reel for her domesticated silk cocoons. The horse, saddle and harness were also among the West's gifts to China. Silk, rag paper, block-printing, movable type and paper money were among China's gifts to the West. China received glass and glaze from Arabia or Egypt, but returned it as porcelain to the West at a later period.

The use of paper and movable type appear among the most characteristic features of western culture, yet the West owes them to the Far East. In the 1st Century of our era, a Chinese Chamberlain, aghast at the cost and inconvenience of bamboo on which to keep records and accounts of the Celestial Court, invented or accepted the invention of paper. He was the eunuch, Ts'ai Lun, not

unworthy of fame, and of him it is said, "In ancient times writing was generally on bamboo or on pieces of silk, which were then called chits. But silk, being expensive, and bamboo heavy, these two materials were not convenient. Then Ts'ai Lun thought of using tree bark, hemp, rags and fish nets. In the first year of the Yuan-Hsing (A. D. 105), he made a report to the Emperor on the process of paper-making, and received high praise for his ability. From this time, paper has been in use everywhere and is called the 'paper of Marquis Ts'ai.' "

It is further recorded of this worthy, that becoming involved in a court intrigue, and wishing to avoid an appearance before the Judges, he went home, took a bath, combed his hair, put on his best robes, and drank poison.

Professor Carter has given us a most significantly dated map of the distribution of paper.

It starts, as I have said, in China, 105 A. D., and arrives in Turfan on the old trade route in 399 A. D.; in Samarkand, 731; Damascus, 793; Egypt, 900; Fez, Morocco, 1100; Spain, 1150; Hirault, France, 1187; Cologne, 1320; and in England in 1494. It follows the same routes as silk, but at a much slower rate of speed. Western people dressed up before they took to literature. Paper did not become a necessity until trade (in Europe) spread beyond the local barter stages.

We owe to China the apricot and the peach and the oat; and to Southern India and China, rice; to Southwestern Asia, the sugar cane and the process for making sugar; and tea, of course, to China alone.

The world owes to China, not the navigator's compass, but the idea which led the Arabs and the Sicilians and the Catalonians to the compass. China's contribution was the needle of magnetic iron which, thrust through a rice

straw, floated in a bowl of water, furnished North and South directions used to re-survey the fields flooded each season by the *Yellow River.*

One of Persia's gifts to China, and to the world, was the domesticated alfalfa, or, as the Persian word implies, "horse fodder." This fine hay is closely associated with the breeding of fine horses for which Persia was famous.

Mention of the plant occurs in Aristophanes' play *The Knights,* in 424 B. C., where it is referred to as "Medic grass" or grass from Media. Alfalfa was known in Italy as early as the 2nd Century, B. C. But it was known in Assyria, according to a translation of a Babylonian Text, as early as 700 B. C.

King Khorasan I, of the Sassanian Dynasty, A. D 531–578, was an up-to-date political economist, with emphasis upon the political. He knew how to raise money by taxation. He taxed the most useful and profitable things. Persia had a great trade in fine horses; these horses were fine because they fed on alfalfa. Hence he taxed an acre of alfalfa seven times as much as an acre of barley or wheat. Persian men did not bring the high prices of Persian horses; hence their food was taxed less than the food of horses. It sounds very much like our present mounting taxation on gasoline.

The Emperor Wu was not indifferent to the beauty of the fine horses of Fergana and Persia. Between 140 and 87 B. C., he sent ten expeditions to Persia to buy these noble animals. And in 126 B. C., the astute General Can K'ien brought back the seeds of alfalfa, shrewdly reasoning that a good horse needed good fodder.

The grape vine and the gracious art of wine-making are among the oldest of man's agricultural efforts. Only the cereal grains are more ancient. This speaks well for

the social life of antiquity. Wine and grapes were known to the Egyptians in the fourth millennium, B. C., and may be equally ancient in Mesopotamia. But they originated in neither of these ancient areas. Brother Noah planted the vine on Mount Ararat from the Ark. But, of course, this was a relatively recent incident in the history of wine. Armenia has been suggested as the first home and the honor has also been claimed for the "Indo-Europeans." Laufer naturally inclines to a Semitic origin. Racial pride is by no means absent from science. But without regard to racial affinities, wine and grapes belong in western Asia Minor. The wines and grapes of modern France and Germany were planted by the Greeks in Gaul before Caesar, and along the *Rhine* by the Romans when that river was a boundary between the Teutonic barbarians and civilization.

The Persians were the most famous wine drinkers of antiquity. Even after the Koran forbade it, they did very well as garrulous and melodious old Omar, with his loaf of bread, his tree, and jug of wine yields ample proof. The Greek historians of the time of Alexander (and later) were shocked at the Persian parties, but, as history records, Alexander got the idea himself. He conquered the East, but Eastern wine conquered him.

The Persians were as famous for their fine wine as for their horses, gold brocades, steel and ceramics, as this following anecdote implies:

The younger Cyrus, when he came upon a particularly fine wine, used to send the half emptied flagons to favored individuals, with the following message: "For sometime Cyrus has not found a pleasanter wine than this one: and he, therefore, sends some to you, begging you to drink it today with those whom you love best."

In A. D. 647 according to Laufer's *Sino-Iranica* the Emperor T'ai Tsun received a bunch of mare nipple grapes purple in color and two feet long, from Yabgu, a Turkish country, which inspired the Chinese historian *Fiiu Yen* to this philosophical observation:

"Wine is used in the western countries, and under former dynasties it was sometimes sent as tribute, but only after the destruction of Turfan when 'mare nipple' grapes cultivated in orchards were received; also the methods of wine-making were simultaneously introduced into China (A. D. 640). T'ai Tsun was experienced in both its injurious and beneficial effects. Grape wine, when ready, shines in all colors, is fragrant, very fiery, and tastes like the finest oil. The Emperor bestowed it on his officials, and then, for the first time, they had a taste of it in the Capital."

Spinach was a Persian vegetable introduced from Nepal into China in the 7th Century. "Well cooked, it makes good eating and is savory," write the Chinese; evidently, they had tried it both ways.

The preference of negroes for the watermelon is founded upon a common racial origin. For the watermelon, called "Melon of the West," originated in South Africa, spread to Egypt, and from Egypt to Anterior Asia, Persia, Turkestan, and China. It is written that Catherine, of Russia, once sent Frederick the Great a crate of watermelons when he asked her for a province.

All-told, twenty-four plants traveled from China to Persia and more than sixty to China from Persia and the western world.

CHAPTER XIV

AMERICA MEETS ASIA

At the very dawn of the 16th Century, there occurred one of the most fruitful exchanges of wealth within the history of the human race. For thousands of years, the great food and industrial plants of Asia had been spreading over Africa and Europe; for thousands of years America, particularly the regions bounded by Mexico on the North and Peru on the South, had been domesticating a series of plants unknown to either Asia, Europe or Africa. These annually recurring forms of wealth were about to be exchanged, or rather multiplied, by the most deliberate and purposeful diffusion the world was ever to know.

The two centuries which follow are historically associated with many other and comparatively trivial matters, such as wars, invasions, conquests and colonizations. But the increase, due to the world-wide exchange of domestic plants and animals, is an absolute gain in world wealth. All areas of the world profited; all areas still profit. The gain is annual and perpetual; the wealth is drawn from income, not capital.

Much stress is laid upon the floods of gold and silver which poured into Europe at this time, upsetting all standards of values, causing an inflation due to the fourfold increase of silver and the somewhat less, but still vast increase of gold. These metals were used for the expenses of warfare and supplied the munitions which eventually drove the Turks from Vienna, but also

drenched the fields of Europe with fratricidal blood. They first made Spain the richest and the mightiest of modern nations and then smothered her glory. This bullion, looted from Mexico and Peru, formed the liquid capital for the fruitful trade with the East, opened by Portuguese energy and Italian mathematical science, but it is as nothing compared to the wealth gained by the world from American crops or gained by America from crops and animals, borrowed directly from Europe, which Europe had received earlier from Asia and Asia Minor.

In considering the wealth men dig out of mines, and the wealth yielded by husbandry and agriculture, we must bear in mind that the latter is a recurrent form of wealth, ever renewing itself. But every ounce of gold, silver or platinum, every pound of tin or copper, every gallon of petroleum, every ton of coal or iron men dig out of the bowels of the earth, reduces by just so much the basic capital of Civilization. But agriculture and herding constantly renew themselves; under prudent and scientific management, they furnish income. The wealth of mines transferred impoverishes one country and only temporarily enriches another. But a transfer of plants and animals makes each country or continent the richer for the exchange. This observation refers, of course, to wealth, not to profit—to society, not the individual.

At the instant of this exchange, about the year 1500 A. D. no New World plants were known in the Old World; no Old World plants were known in the New World. To this statement there are a few minor qualifications. There seems little reason to doubt that the Polynesian navigators and colonizers of the Pacific Islands had

touched at times upon the Pacific coast of Central and South America and borrowed the sweet potato and left behind the cocoanut. The cocoanut may, of course, have drifted here by accident.

The other seeming exception, cotton, which is prehistoric in both areas—the Indus Valley and Mexico and Peru, and the Southwest of the United States, is only a confusion in botanical terms. The cottons of the New and the Old World are distinct species. Fertile crosses can not be made between them, since the Asiatic type has thirteen chromosomes in the seed cell and the American type twenty-six. This fact may have significance for the botanist but none for the economic historian. In both areas, and without the influence direct or indirect of diffusion, textile-minded peoples came upon these delicate seed hairs and invented identical mechanical methods to convert them into yarn and cloth. I propose to consider this problem in relationship to other problems in the general history of cloth.

Let us first see what the Old World sent to the New World before we consider the New World's contribution to society at large. I quote from Elmer D. Merrill, in the May–June 1933 issue of *Natural History*.

"Eurasia, particularly Asia, as contrasted to America, yielded a very much larger number of basic food plants as well as most of our domesticated animals, including all breeds of cattle, horses, camels, buffaloes, yaks, sheep, goats, swine, geese, hens, pigeons, and most kinds of ducks. Other than maize or Indian corn, all the true cereals originated in the Old World, including wheat, rye, barley, oats, millet, Italian millet, pearl millet, sorghum, rice and others of minor importance such as teff, ragi, and coix. In addition to the true cereals may also be

listed buckwheat, and among the vegetables the turnip, cabbage, rutabaga, rape, chard, mustard, radish beet, parsnip, carrot, onion, leek, garlic, shallot, spinach, egg-plant, lettuce, endive, salsify, celery, asparagus, globe artichoke, pea, soy-bean, cow-pea, chick-pea, pigeon-pea, lentil, broad bean, hyacinth bean, asparagus bean, taro, yam, sugar cane, sesame etc.; among the fruits the apple, pear, plum, cherry, wine grape, apricot, peach, prune, olive, fig, almond, persimmon, quince, pomegranate, jujube, melon, watermelon, cucumber, and in the more tropical regions the banana, cocoanut, orange, pomelo, lemon, lime, date, mango, breadfruit, jak-fruit, rambutan, litchi, longan, mangosteen, and others.

"Practically all of the cultivated forage plants, including the hay grasses, clovers, and alfalfa, are of Eurasian origin. As none of these were known in America previous to the beginning of the 16th Century, so none of the shorter American list were known in Eurasia until after the same date. The effective interchange of economic plants between the two hemispheres dates from the beginning of European expansion and exploration at the close of the 15th Century."

To this already imposing list should be added almost all American domesticated plants, trees and bushes. And just to keep the records clear, as to the New World's debt to Asia, and at the risk of repetition, she also owes to Eurasia her fundamental technical and social devices such as the use of iron and steel, gun-powder, wheeled vehicles, and implements, depending upon the principle of the wheel, the cog, and the roller, the ocean-navigable sailing ship, the plow (master of its millions of acres), her language, method of writing, her social philosophies and religions. To these again may be added the multiple

devices of the later era of mechanical power invention.

If Europe's debt to Asia and to the Near East is great, America's debt to Western Europe, and indirectly to these more ancient civilizations, is not small. Yet in these fundamental exchanges, Europe is from first to last only the middle-man. She improved and modified many technical ideas of Asiatic origin. She improved, vastly improved, the breeds of animals and plants. The scope of these improvements entitle her to the consideration of at least re-invention. But she added to the world no new plant or domesticated animal. All these plants and animals, and also technical ideas, all metals, looms, furnaces, wheels, etc., she owes to the "backward peoples of the East"—the so-called white man's burden of the complacent philosophy of the 19th Century.

The agricultural contribution of the Americas, principally from the plateaus of Mexico, Bolivia and Peru, was by no means small. Clark Wissler in his *The American Indian* lists thirty-four important plants cultivated by the American Indian before the discovery of the New World in 1492.

Name	*Area of Cultivation*
Agave, or aloe (*Agave Americana Linn.*)	Mexico to Chile
Alligator pear (*Persea gratissimo Gaertn. f.*)	Central America and West Indies
Arrowroot (*Marania arundinacea Linn.*)	Tropical America
Barnyard grass (*Echinochloa crusgalli* [L.] *Beauv.*)	Mexico and Southern United States
Bean, kidney (*Phaseolus vulgaris Linn.*)	Distribution same as maize
Bean, Lima (*Phaseolus lunatus L. var. macrocarpus Benth.*)	Brazil and Peru
Cacao (*Theobroma cacao Linn.*)	Tropical America
Capsicum or Chili pepper (*Capsicum annum Linn. and Capscium frutescens Linn.*)	Tropical America
Cashew nut (*Anacardium occidentale Linn.*)	Tropical America

Name (continued)	*Area of Cultivation* (cont'd)
Coca, or cocaine (*Erythroxylum coca Lamarck*)	Peru and Bolivia
Corn (*see* maize)	
Cotton (*Gossypium barbadense Linn.*)	Tropical America
Cherimoya (*Anona Cherimolia Miller*)	Peru and Brazil
Gourd (*Cucurbita pepo var. ovifera Linn.*)	Distribution same as maize
Guava (*Psidium guajava Linn.*)	Tropical America
Jerusalem artichoke (*Helianthus tuberosus Linn.*)	Mississippi Valley
Madia (*Madia sativa Molina*)	Chile
Maize (*Zea mays Linn.*)	
Manioc (*Manihot utilissima Pohl.*)	
Mate or Paraguay tea (*Ilex paraguariensis St. Hil. and Ilex conocarpo Reiss.*)	Paraguay and Western Brazil
Papaw (*Carica papaya Linn.*)	West Indies and Central America
Peanut (*Arachis hypogaea Linn.*)	Peru and Brazil
Pineapple (*Ananas sativus Schult. f.*)	Mexico and Central America
Potato (*Solanum tuberosum Linn.*)	Chile and Peru
Prickly pear or Indian fig (*Opuntia ficusindica Mill.*)	Mexico
Pumpkin (*Cucurbita pepo Linn.*)	Temperate North America
Oca (*Oxalis tuberosa Molina*)	Chile and Bolivia
(*Oxalis crenata Jacq.*)	Chile and Bolivia
Quinine (*Cinchona calisaya Wedd.*)	Bolivia and Peru
(*Cinchona officinalis Linn.*) and others	Bolivia and Peru
Quinoa (*Chenopodium quinoa Willd.*)	Colombia and Peru
Squash (*Cucurbita maxima Duchesne*)	Tropical America
Star apple (*Chrysophyllum cainito Linn.*)	West Indies and Panama
Sweet potato (*Ipomoea batatas Poir.*)	Temperate America
Tobacco (*Nicotiana tabacum Linn.*) and other species	
Tomato (*Lycopersicum esculentum Mill.*)	Peru

In order to establish some measure of quantitative values for world agriculture, the map of world crops from *Economic and Social Geography* by Huntington, Williams and Valkenburg, becomes more than useful. It is illuminating. In this map, the actual areas in terms of

square miles and acres occupied by all of the world's crops has been super-imposed upon a map of the United States and the southern or habitable portion of Canada. If every square mile of this area were of suitable, arable land, for the cultivation of the various products, and if every square inch of this area were utilized, it would contain all of the world's crops grown today.

All of the world's corn, grown in practically every country of the world today, could be contained within the states of Texas and Louisiana; all of the world's cotton, from the vast plantations of India, and Africa, and the United States, could be contained in Georgia, North and South Carolina; if all the world's grain fields, exclusive of corn (maize), were moved to the United States, they would occupy the whole of the United States west of the Mississippi; rice would occupy an area equivalent to Oregon, California and part of Nevada; oats would cover only New Mexico and Arizona, with a little of Nevada; millet, the favorite grain of the Nomads, would cover Colorado and Utah. Fresh vegetables, root crops, and miscellaneous crops, like spices, would cover an area smaller than Ohio and Michigan. Fruits and nuts and wine grapes would cover Kentucky and West Virginia.

All the world's sugar could be raised on areas equal to Maryland and Delaware and about one-third of Pennsylvania. And all the tobacco raised in the world today would occupy an area less than one-fourth the size of the State of Virginia; copra a slightly larger area; olives a little less; dry beans and peas, New York, New Jersey and New England, and the world's mulberry trees, which limit the crop of cultivated silk, could be contained in a little more than half the area of the tiny state of Rhode

Island. The world's fodder crops, hay and permanent pasture, might be contained in an area represented by the states of Washington, Idaho, Montana and the inhabited portion of southern Canada.

Since the United States represents only about one-seventh of the arable surface of the earth, this limitation of space now reserved for all the world's crops, shows the value to society at large of land suitable for tillage of any kind. It should be guarded, and jealously guarded, from every factor which would diminish it. It has taken society 20,000 years or more to arrive at this condition. We have adequate historic examples of the carelessness of man in Western Asia and Asia Minor, once the earth's most fertile acres, but now the victims of raging floods and burning droughts. The areas of China and the United States flooded annually warn us of our approaching peril. And should the vast forests of Thibet be denuded, should hillside agriculture follow the devastation of these forests, then the great rivers of China and India would cease to nourish these great plains and famine would stalk the most thickly populated of the earth's nations. If man needs a foe to fight, it lies here, and not on some battle-field of man against man—machine against brute machine.

Since the Old World never knew any American plants until the 16th Century, and since the Americas never knew Old World plants until the same time, then the value of New World plants in the Old and Old World plants in the New, give annual measures of the additions made to world wealth by these exchanges. If the sum of all such agricultural wealth that has accrued since the 16th Century were published, it would mean such in-

credible figures that no wise man would attempt to put them in any book.

In this same century, the first grain of wheat came from the East to the New World. In 1935, the United States produced 603,199,000 bushels of wheat, no grain of which was ever in the New World until brought here by European colonists. In the same year, the United States harvested 1,195,435,000 bushels of oats; 57,936,000 bushels of rye; 111,271,000 bushels of barley; 8,234,000 bushels of buckwheat; 38,452,000 bushels of rice; 4,486,000 tons of sugar cane; 24,699,000 cans of syrup; 8,000,000 tons of sugar beets, together with hops, clover, alfalfa seeds, cow peas and millet beans; 8,000,000 boxes of lemons; 18,903,000 bushels of peas; 8,371,000 bushels of onions and 790,100 tons of cabbage. The United States did fairly well in the exchange of plants.

In the year 1933, the production of the world's chief crops, as given in *Economic and Social Geography,* was as follows:

(Reckoned in 2,000,000 of pounds.)

	North America	*Europe*	*Asia* *	*South America*	*Africa*	*Australia*
Rough rice	2,100	2,200	280,000	2,400	5,300	65
Wheat	78,000	120,000	70,000	17,000	7,000	9,000
Corn	158,000	39,000	11,000	26,000	10,800	520
Oats	92,000	92,000	5,300	2,500	540	680
Rye	3,300	96,000	?	380	45	4
Barley	19,000	46,000	21,000	1,700	5,000	340
Potatoes	29,000	360,000	17,000	4,000	4,800	1,100

* Including rough estimates for China.

Most of the present world's crop of cotton springs from American seeds which began to be distributed by Portuguese navigators in the 16th Century. Of the

world's crop in 1933, of 23,600,000 bales of 500 pounds each, only 10,600,000 were grown in the United States The rest, with the exception of the Peruvian and Brazilian crops, must be credited to the Americas on the books of civilization.

But wool is different. No domesticated sheep were known in America until introduced by the Spaniards and other European colonists in the 16th and 17th centuries In 1935, the world's wool clip was 3,460,000,000 pounds and that of the United States, 429,100,000 pounds. To this clip we must add those of Mexico, Canada and South America to establish the New World's debt to the Old in wool.

Silk from cultivated cocoons has shifted about less than any major crop. This is due to the fact that in relatively small areas of the world do we find a high degree of horticultural skill necessary to cultivate the mulberry tree, accompanied by very low money wages, (about twenty cents per day). Hence, in all the great changes in textile crops, silk has remained most nearly constant to its original home. The principal world crop now comes from Japan and China, with a little from Italy and France, and small crops from Spain, largely used to make the finest gut used for fishing leaders.

Some comparison between cultivated silk and synthetic fibers may not be entirely out of place.

In the year of 1911, the world's production of silk was 57,143,000 pounds, and of rayon 18,700,000 pounds, of which latter the United States produced only 364,000 pounds. In 1915, the world's production of silk, due to various causes, including the high cost of ocean transportation during the World War, dipped to 53,088,000 pounds, and the world's production of rayon dipped very

slightly to 18,500,000 pounds. But the production of rayon in the United States had risen to 3,885,000 pounds. In 1919, the end of the War, the world's silk prduction had risen to 61,040,000 pounds, and the world's rayon production to 25,900,000 pounds, and the United States production, or share, of this was 8,278,000 pounds. The highest yield of the world's silk production occurred in the year 1934, when 115,000,000 pounds of silk was produced, while in the same year the world produced 769,-400,000 pounds of rayon, and of this total, the United States produced 208,496,000 pounds. In the year 1921, the production in pounds of rayon for the first time exceeded the world's production in pounds of silk. The figures were silk, 67,200,000 pounds, and rayon, 202,600,-000 pounds. In the year 1935, the last available figures at this writing, the world produced 95,000,000 pounds of silk and the gigantic total of 936,100,000 pounds of all types of synthetic fibers, or almost ten times the poundage of silk.

It is evident from these figures that the production of the synthetic fibers has had no effect on the rise or fall of the production of silk. Our records extend from the year 1911 to 1935, a period of almost a quarter of a century. The production of silk is governed by natural changes and by the trends of commerce. It rises or falls, apparently, by rules and regulations which affect more or less all natural products. The rise of the synthetic products have followed rules of their own, and they have helped, rather than retarded the development of the consumption of silk.

The value of rubber was known to the natives of the *Orinoco* and to the *Amazon* valleys long before the advent of Western European technical culture. It was used

for water-proofing, for enema syringes and rubber rings and even balls which were objects of trade as far north as Mexico and Yucatan. Europe, in the middle of the 19th Century, used it in water-proofing clothing, for insulation of telegraph wire and for toys.

Sometime before the World War and the modern age of the automobile, plants were taken from Brazil to the Malay Peninsula and Indian Islands and cultivated under English and Dutch direction. During the War, so great was the demand for the wild rubber of South America, that Manãos, thousands of miles up the *Amazon,* the center of the wild rubber trade, had a burst of pyrotechnical prosperity, a Grand Opera House, a *nouveau riche* complex and a subsequent panic which darkened the Opera House and much else. American automobile capital has now begun to develop scientific cultivation in the original home of the rubber plant, in the jungles of South America and the cultivation of the rubber plant has been begun in Africa. To put the matter in more concise form, a wild plant, located in an almost unknown New World rain forest, within less than a century, has become a major cultivated crop in two continents, as well as an essential raw material in many basic industries. This proves how an exchange of cultivated plants between two areas increases the wealth of both and the total wealth of the world.

In 1910, the world produced 93,950 long tons of rubber, only 10,616 tons from trees cultivated in the East Indies. In 1935, the world's production was 863,007 long tons, 843,197 tons of which had been grown on plantations from trees cultivated from wild Amazon plants. The fluctuation in price, during the late part of this period, ran from a high of $1.29 per pound to a low of 1⅞ cents

per pound. Chemists have produced a synthetic rubber that may some day take the place of the natural product or at least control its price.

Among the Asiatic plants recently brought into the United States from Asia, soy beans and tung oil nuts are the most important. Soy beans are valuable for their oil and to improve worn-out soils as fodder crops, and as the basic element used in certain plastics of great value to the automobile and electrical industries. Tung nuts have been for centuries a wild harvest in China. The oil has been used as a preservative and also in the manufacture of paint and varnish. Within the past few years, more than 20,000 acres of cut-over forest lands in Mississippi and Florida have been planted with these trees and expert methods of reducing the oil developed. This has not checked our importations of Chinese oil, but has increased our consumption and equalized the price of this essential oil.

I have by no means exhausted this subject by these few hasty comparisons. What has been suggested is that the exchanges between the Old and the New worlds have added to the wealth of the world at large. This wealth is in no wise responsible for the economic and social confusion associated with the increase of wealth. The amount of the actual increase of this wealth may be roughly estimated by adding the value of all Old World plants and animals now cultivated or domesticated in the New World to all New World crops grown in any other part of the world. To this must be added the wealth resulting from the processing of these raw materials and the upbuilding of industries and the spread of world commerce.

CHAPTER XV

THE DEVIL AS AN INVENTION

THE abundance of such obvious good as wheat and wagons, pottery, cloth and metals and patient animals, which begins in the Neolithic Age, made it necessary for man to explain both the existence and the persistence of Evil. So he invented the Devil, and the Devil invented Logic. And Logic created War.

There was night and day: white and black: hot and cold: strong and weak: sick and well: sweet and sour: old and young: hence, there must be Evil as well as Good. All things went by comparison. How could you measure Good except by Evil? How could you enjoy Peace without War?

Everyone, except a stubborn few, accepted with delight such reasoning. It was inspired; it did not require a lot of dull facts to prove itself; it was an obvious formula—no one had to think it out.

The Devil, when once invented, had to look out for himself and provide for his progeny. Being both a philosopher and a practical economist, he went about the matter with sound judgment. An illusion himself, he knew the value of illusions.

With prophetic satisfaction, he viewed this digging and plowing of the earth, this planting of seeds and this tending of the ranging herds; the fat granaries and the crowded byres.

Man now looked upon the earth as never man had

looked upon this earth before. It was "his"; he alone had wrought it from the wilderness, and caused it to bring forth plenty in season. And so the Land became the Tribe and the Tribe became the Land and each rejoiced in the other exceedingly and each after their natures. That the Land acquiesced was evident in the recurrent harvests. Man thus learned loyalty towards land, towards some certain area of the earth's surface that was "his."

The Devil's good manners have been praised even by those who claim to dislike him. So he turned his head aside to smile. For he knew that these tiny fields eating into the ancient forests like moths in summer furs, these spreading pasture lands would in time reach out and touch other fields and other pastures where men knew other gods and spoke with strange tongues but had the same loyalty to land. And he also knew what would happen when these loyalties met and blazed in one consuming fire.

It was after such an event had occurred that the men, weary of slaughter, leaned upon their weapons and began to consider the matter and to ask questions: "Of what use are these?" they inquired pointing to the Dead. "Were they beasts of the chase, we might eat them and use their hides. But now we must plant them in the ground lest they stink. This is not a harvest. There is no profit in the matter."

"True enough," replied the Devil who was fair-minded when the facts were too obvious. "Your otherwise admirable enthusiasm carried you away this time. Next time, save a few; they will be useful to tend the fields and herds which once were theirs, but which now are yours. Shall there not be a harvest of swords?"

And the Devil caused the poets to sing, not of the

honest wheat, nor the sturdy plough, nor the strong oxen; but of the Red Reapers and the Crimson Harvest. And over the smiling, fruitful earth, upon a sudden there fell a ruddy mist in which men saw the shape of strange and new desires. And again the poets sung of the trusty blades and the madness that swells in man's hearts.

"Are ye not in all ways superior to those who once were men but who now are far otherwise?" asked the Devil, when the poets paused for breath.

"It seems to me that the proof could not be clearer. The choosers of the Slain selected them, not you."

"It was a bitter choice," said a man limping on a wounded leg. "The day was heavy and none too certain. We might have been about matters of greater profit."

"You conquered your enemies," retorted the Devil.

"What is an enemy?" asked the man, for the word was strange to his ears.

"An enemy," replied the Devil, "is anyone who speaks with a strange tongue and has different gods from yours, more especially if he is not too far away, and has fields and herds which might be yours except for his insolence. Do you want to lose your fields and herds and have your children killed? Do you want to be forced to speak with strange tongues and reverence strange gods?"

"No," said the man. "But had it gone otherwise, then they would have taken our fields and herds and used our children, even as we have used theirs."

"Then reward the brave fellow who saved you," replied the Devil. "These fields and herds now belong to the brave; and also give tithes to the priests." For the Devil noticed that the priests looked darkly on the matter. "Also talk less: a cackling tongue is the sign of a traitor."

"What is a traitor?" asked another man.

"A traitor is one who does not hate all men who speak with strange tongue and also their fields and herds," replied the Devil.

"Must we now hate these fields? They seem to lie well. And the herds are fat. I have taken a great fancy to them," said the man.

"These fields and herds are now yours. It is your duty to love them, since they now belong to men of Honor," said the Devil.

"What is this thing called Honor?" asked a sturdy fellow dragging a plough out of a burning hut. "I have searched about but could find little to my taste except this plough. Is Honor a better plough, a swifter horse or a more fertile wheat or a stronger ox?"

"Honor," said the Devil, bowing as to an equal, "is none of these things. Yet all of these things. Honor sees to it that men without honor tend and care for these things for men of Honor. Honor is a condition of Honor, not a kind of work. It concerns profit, not production. Men of Honor do not sweat."

"How can a man come by this so desirable Honor?" demanded the sturdy fellow.

"At least not with a plough," smiled the Devil.

"I will sell this rascal plough for which I now have so strong a distaste and buy a fine bronze sword," cried the sturdy fellow.

"That will prove to all men that you are indeed a man of Honor," said the Devil. "But I have learned that a new smith has come into the valley who makes still better swords of a metal called iron. Of course, he wants to sell these swords to these fine people here, but he is a business man and the tribes of the North are bringing

down amber and furs and slaves to trade with him. Also do not forget a strong bow and a good horse."

"I go now to seek out this smith," said the man, kicking aside his plough. "I am for this Honor; it is better than ploughing."

"It is our duty to keep abreast of the times," said the Devil.

So the Devil was contented. The matter lay in good hands. He could afford to rest. From time to time there came Voices which disturbed him; but seldom, very seldom, indeed.

The Devil knew, through the arts of prophecy, that each new invention of fruitful man, intended to relieve want, to increase abundance, to surmount difficulties, would also pay its tithe to War. The disturbing voices in time would become echoes reverberating against the walls of man's prejudices, turning into twisted phrases and distorted meanings, and these ancient echoes would stifle the new voices and sound in men's ears like the beatings of the war drums.

CHAPTER XVI

A VERTICAL APPROACH TO MECHANICAL CULTURE

EACH phase of social history, from a primitive tribe to an empire, has its own peculiar content of technical invention, but is also connected with the past by surviving inventions. This technological environment is conditioned upon internal creative forces, adaptation and intrusions. The factor of time is only of relative importance since invention is a cumulative process.

Any society may be studied from the viewpoint of its social and mechanical content without reference to any past. This may be referred to as the horizontal approach. It is the approach usually pursued not only in orthodox written history, but also in the arrangement of documents in art and ethnological museums in attempts to present coherent patterns of given cultures at specific points of time.

For example, modern Western European technical culture includes a liberal use of various types of metals with special emphasis on the ferrous alloys, a high degree of mechanical power, steam, electricity, and various forms of the combustion engines, precision tools, automatic machinery, chemical research and the relationship between the scientific and the industrial laboratories. It is separated, apparently, from all past ages by a vastly increased physical abundance and by a multiplicity of methods of communciation and transportation.

When, however, we approach the modern age from the point of view of languages, art, literature, philosophies and religions, we are forced to abandon the horizontal method and seek for the basic culture factors along vertical lines which sink deeply through many culture strata.

Any comprehensive study of a horizontal area will reveal the dominant mechanical ideas in embryo in preceding ages. No age, therefore, is mechanically, nor completely comprehensible on the basis of a horizontal distribution of ideas alone. All cultures are ladders of many rungs.

Certain culture factors of our mechanized age retreat into the dimmest conjectural records of the earliest visible hominids, the man-like creatures of the moist warm jungles of England and Central Europe, who preceded by hundreds of thousands of years man's first encounter with the ice. We are separated from these ages not alone by time, but by fundamental physical differences and by seemingly impassable technical gulfs. Yet they knew the principle of the cutting-edge, the simpler uses of fire, possessed a rudimentary social organization and, perhaps, speech. We are still in the age of fire. It has its thousands of uses today. We have applied the cutting-edge to immeasurable uses, and are still engaged in adjustments between mechanical and social forces and the spoken word is still a vital element in the exchange of thought.

Between these remote periods of mechanical culture, lie many strata of invention. From bottom to top, society is an ever-increasing integration of ideas. Fundamental changes occur in brief intensive eras of creative thought followed by more or less important muta-

tions in the forms and intensity of inventions and consequent social changes. Material culture is like a river flowing through society; sometimes in sudden floods, sometimes underground, sometimes in long, placid, slow-moving pools in which ideas accumulate; but always in motion.

From the Ages of Ice, we have inherited the cutting knives and scrapers of stone, the awl and eyed needle, button and toggle of bone and ivory and the idea of tailored clothing. Here do we first meet Art. The harpoon begins in this age and also ideas regarding some life beyond the physical manifestation of life. This led mankind to a groveling fear of occult forces, to bewilderment, and cruelty, but also to some of the sublimest conceptions of the human mind reflecting the great source of all thought and power. Surely we cannot deny a vertical relationship to these ages, however remote they may be in time.

With the great Neolithic Age (wheat, wagons and war) there occurs a world-wide distribution of ideas which clearly define this age as the first of modern eras. Here occurs a great concentration of new inventions and discoveries and an equally impressive distribution of ideas, varying in intensity in various areas, but practically world-wide in some phases of new ideas.

It is in Asia Minor and the Mediterranean basin, Central and Northern Europe and, to a lesser degree, England, that the full effects of this age of invention are felt. Cereal, grain, the ox, sheep, horses, swine and goat, pottery, weaving, navigable boats, copper, bronze, early iron, wheeled vehicles, trade, slavery, war as a profession, established communities, fortifications and a vast distinction between hunting gears and weapons for war, the sword, the sickle, and the bow and arrow, defensive

armors, the ox and plow and the war chariot, all belong in this age.

Here we meet, perhaps for the first time, the racial ancestors of modern Europe. Here we see the broad technological basis of ancient and classical civilization and the dawn of modern technology. Many of these early civilizations did not make use of the full quota of Neolithic technical ideas; none fall beyond the limits of the Neolithic, if this term is used with a rational broadness. Egypt and Sumer, Assyria, the Indus Valley and Shang China, are Neolithic in their technology. Cyprus, Crete, Mycenaen and classical Greece, even Rome, herself, were technically based upon ideas that would have been clearly comprehensible to later Neolithic man.

Constantinople, which lived in the great tradition of the past for 600 years after Rome had fallen, and which bequeathed to its later Italian despoilers the precious gifts of antiquity, did not create any new primary mechanical ideas, though it added vastly to the ideas it had received and was a vital link between past and present in technology as in other matters.

The Dark Ages of Europe, which followed the economic and political fall of Rome, are dark largely in our lack of perception. They were ages of uncertainty, cruelty and misery. Yet they were centuries of stubborn enterprise. Society in relatively small groups centered about strong military leaders or monasteries, fought a stout battle against gloomy forests and great fens and marshes, peopled with savage beasts and still more savage men. Our legends of trolls and giants, werewolves, and demoniacal bears, the terrible sagas of the North, all speak eloquently of the fierceness and duration of this struggle. The reward was, and still is, one

of earth's most fertile areas proving what man can do when he turns his face and tunes his courage to high enterprise.

What were man's weapons in this struggle? The hoe, the harrow, the metal furnace and forge, the plow; the castrated ox, the horse, sheep, the wheeled vehicle, wheat and barley, oats and rye and orchard trees, buildings of stone, sailing boats, and trade; pottery, and the loom; none of which fall beyond the limits of the technology of the Neolithic Era.

These cultures flowered in the great 12th and 13th centuries. Here Europe had associated language, religion, civil customs and technical inventions in one balanced social pattern. Here is the visible result of more than a thousand years of culture based upon common mechanical inventions which are many thousands of years more ancient.

To pursue technical historic facts by the horizontal method is impossible during such an era, or, rather eras, so different in outward appearances and social forms. From Sumer and Egypt, and even before, to Gothic Europe, we are dealing with one general set of mechanical inventions but many degrees of civilization.

It is evident that we must abandon the horizontal presentation and apply the vertical method to a few selected inventions.

I have, therefore, chosen four ideas of great antiquity, of present day importance, and of world-wide distribution for this purpose: Cloth, Transportation, Iron and Tobacco.

Cloth is common to both the Old and the New World and in both areas it reached the ultimate in technical variety, physical perfection and artistic elegance in an-

cient times. Central Asia, the Valley of the Indus and Western China, and pre-historic Peru, contain these distinguished pre-European records. But the modern phase of mechanized production is the outcome of the technical evolution of automatic power machinery in Western Europe with particular emphasis on the last century-and-a-half in England. Today the world's textile industries, whether of modern or ancient technology, employ more than 14,000,000 workers. Cotton, wool and synthetic fibers are estimated in billions of pounds and silk reaches a world production of an average of 100,000,000 pounds per annum.

Transportation was one of society's earliest needs and some form of transportation exists all over the world. With the exception of the Asiatic dog and the Peruvian llama, no domesticated animal belongs to the western hemisphere and no form of wheel occurs in the New World until European intrusion. Wheeled vehicles, the ox, horse, camel, reindeer, elephant, etc., belong to Asia, and the sail-boat to Egypt; but all mechanical forms of steam, electricity, combustion engines, steamships, railways, locomotives and automobiles belong to western European technique and date from the last half of the 18th Century. The United States is the latest in this field, but far exceeds the rest of the world in quantity and quality of methods of transportation.

Men first knew iron from meteorites, "Metal of the God," but began smelting it from ores at least 3,000 years before our era. The art of iron-smelting arrived in Italy about 1,000 B. C. Up to the 14th and 15th centuries there is little change in technique. But by the end of the 15th Century, Europe had developed a new kind of furnace which ushers in the second age of iron, the era in which

iron becomes "cheap" and hence more useful. In the late 17th Century, the iron industry was almost lost to England until the coke oven was perfected. Within the last 83 years, the productivity of iron and steel, or rather ferrous alloys, has increased more than thirty fold per unit of labor and the United States has become the world's largest area of both production and consumption.

I have selected tobacco to prove that whim has more force in world commerce than want. Both this primitive narcotic plant, and the habit of smoking it went around the world in a century after the discovery. Within fifty years it had met and conquered the opposition of the greatest rulers on earth. It has yielded more revenue than either gold or silver mines. No one ever needed tobacco, yet today the world each year produces and consumes over five billions of pounds of a product unknown to the rest of the world outside America until the 16th Century.

CHAPTER XVII

CLOTH—ITS SOCIAL HISTORY

THE modern or the mechanical phase of cloth is amply contained within the past 200 years, with special emphasis on the last century. Within this brief space of time, the machines and processes which evolved in England in the 18th and early 19th centuries have spread all over the civilized world. To the English inventions and systems, France, Germany and the United States have made important contributions in the form of specialized machines, but the basic inventions and the coördination of these inventions into the modern power-driven factory, are English.

The modern era of mechanical production of textile products by power-driven automatic machinery belongs within that same general group of impulses which gave to the world the first practical steam engine, the first steam locomotive on rails, the first steamship, the first general mechanization of all basic industries, and the culminating scientific achievements which lead to the modern science and industry of electricity. All these achievements are English, even though English genius and energy drew many inspirations from the Continent.

This is one of the most important epochs in human history. It can be compared only to the Neolithic intrusions into Europe, discussed in an earlier chapter. Society is still in the early stages of this era. Its full social and economic implications are by no means

clearly understood: its mechanical progress has by no means reached anything remotely resembling tranquility.

Up to the time of this curious phenomenon of the concentration of mechanical textile invention in England, England had lagged far behind the European continent in all industrial matters, and particularly in the textile arts. Her early economic history is that of a producer of raw materials—of tin, lead and hides, of wheat and cattle, of wool and rough homespun, undyed and unfinished cloths, sent to the skilled industries of Italy, and later to the low countries and Holland, there to be dyed and finished and re-entered into the currents of world trade.

As early as the time of the Conquest (1066), foreign workers in textiles had come to England. Edward III gave great encouragement to later industrial emigrants, nor were other monarchs, including Elizabeth, less far-sighted in these matters.

The brutal victories of the Duke of Parma, in Holland (1585), and the tragic sack of the great trade and industrial city of Antwerp, added to England, among other things, skilled weavers of fustians and caused the word "cotton" to appear for the first time in the records of the great city of Manchester. The Revocation of the Edict of Nantes, which renewed in France the bitter conflicts between Catholics and Protestants, drove to England thousands of skilled Huguenot workers, trained textile experts, merchants and capitalists, who created in England, in the latter part of the 17th Century, the finer arts of modern textiles. They introduced light-weight, fancy woolens, silks of various kinds and superior methods of printing with carved wooden blocks. These "new

cloths" made a great change, not only in English industries and exports, but in English sartorial habits.

It is customary to attribute to the Revocation of the Edict of Nantes, the rise of the English textile industries and the dawn of modern textile invention. But the same forces operated to develop textile industries in Germany, Switzerland and Holland. The effect of these emigrations is beyond question. Any one of these other nations might easily have been the scene of the development of the modern machine and the modern mechanical methods of factory production. As a matter of fact, mass production (which is the essence of these systems) appeared rather earlier in Sweden in the metallurgical industries than in England, so we cannot advance the theory of 17th Century emigration into England as a complete explanation for the mechanical versatility of England in the 18th Century. There are evidences in most of these nations of attempts at machine invention in textiles long before the English creations.

All of Europe, including England, was vastly affected in the textile arts by Vasco da Gama's memorable voyage around the Cape of Good Hope in the latter part of the 15th Century, and the great development of trade in calicoes and chintzes, as well as spices and Indian and Chinese silks which were the distinguishing features of world trade in the 16th and 17th centuries. There is no doubt that the influence of this Oriental trade was profound, and proof of this influence lies in the fact that all nations (with the honorable exception of rational Holland) eventually passed laws prohibiting the importation of calicoes and Indian and Chinese silks, in the belief that these inspiring forms of merchandise would destroy or hamper the older es-

tablished woolen, silk and linen industries. Here again we find England and the nations of the Continent open to the same influences and we cannot plead that the introduction of printed cottons and Oriental silks inspired English mechanics alone in attempts to produce these desirable products by mechanical methods.

To plead that England had a peculiarly energetic, ingenious and persistent population is somewhat beside the point, since the English population then, as now, was composed of a mixture of every racial element in Europe, with the exception of the extreme South. The truth seems to be that only in England was there a sufficient political security, a sufficient exemption from wars of evasion, to permit of a proper atmosphere in which new inventions might come to life.

There is perhaps, a second, somewhat less flattering explanation. Ever since the Black Death in the 14th Century and the consequent enclosure of land for sheep grazing (because of a temporary dearth of farm labor), and the disenfranchisement of the small land owner and farmer in England; ever since the breaking up of the monastic estates by Henry VIII and the enclosure of more millions of acres of land for the favorites of Queen Elizabeth, England had faced a serious unemployment problem. This had created a surplus of labor, or rather a surplus of population, which made it possible for England to be more successful than France or Holland in her 17th Century Colonial ventures. These conditions also created a reservoir of labor unprotected by social customs or legal enactments, who were a constant invitation to the mechanically minded as a source of cheap labor. This fact led ultimately to the most tragic labor conditions the world has ever known.

It must not be assumed that England ever was particularly cordial to the textile emigrants upon whose skill her later destiny was to depend. The different rulers of England did indeed invite and encourage textile emigrants because they could collect taxes from them once they had established themselves. The emigrants were as well sheared by the tax collectors as were the English sheep. The first of these emigrants were a group of Flemish weavers who petitioned Queen Matilda at the time of the Conquest of England for a haven from the oppressive taxes of their Duke. They were driven into the bleak and terrible north of old England, as one account says, "like condemned prisoners."

The attitude of the Great Merchant Gilds, long established in the towns of England, particularly London, and who dealt in foreign luxury products, especially the fine cloths from Italy, were far from friendly to these first weavers. The weavers were forced to buy their wools and dyes from these merchants; they could not sell their finished products except to these same merchants. No weaver or fuller could testify against a merchant in any court, and, if a weaver desired to become a merchant or burgher, he was forced to remove all of his tools from his home. No weaver could go beyond the limits of any town to sell his wares; and, lest he be tempted to do so, he was forbidden to have in his possession at one time more than five ells of cloth; or to possess private property beyond his tools, over one penny in value. The weavers are described as a dangerous and radical class, peculiarly open to the suspicion of heresy, for which they were often persecuted.

In the 14th Century, a curious institution came into existence, known as the "Staple." Originally this term

meant a group of organized merchants dealing in commodities upon which royal taxes were levied, and who, for a consideration, made themselves responsible to the King for the collection of these taxes.

The merchants of the Staple were men of might in their own day; but the term soon came to mean the town. or towns, where it was legal to sell commodities subject to Royal excise, or rather where it was convenient for the King to collect taxes on these commodities. In theory, the King was supposed to allow the Staplers or rulers of the Staple to fix these locations. In practice, however, the Kings made selection of these Staple towns in such a manner as to increase their own revenues rather than in the interests of commerce or industry. The privilege of being a Staple town was bought and paid for, just the same as any bag of greasy wool, bar of tin, bale of hides, or pieces of rough woolen cloth. The Staple was ultimately extended to such commodities as cheese and salt first and even willow withes from which baskets were made. It was a form of regal graft.

Between 1326 and 1398, the Staple shifted back and forth between English towns and Calais and Bruges and back again to Calais and Bruges and to the English towns of Newcastle-on-Tyne, York, Lancaster, Norwich, Westminster, Canterbury, Exeter, and others. Every time the King needed a little extra money, the privilege of the Staple was re-sold to some new and hopeful group of merchants. By 1398, nobody paid much attention to the Staple, since ways and means to avoid it had been evolved by the merchants. If governments or kings could have discouraged merchants from the ways of commerce, then commerce must have died out centuries

before the Christian Era. When the French captured Calais, in 1538, the Staple was removed to Bruges. Its sales value had apparently been reduced to zero.

One of the most interesting phases of early English textile history was the trade established between England and the famous Callimala Gild of Florence in rough woolen homespuns. The Florentine merchants took off the rough English cloths woven in cottages and small weave sheds, finished them and dyed them in Florence, and sold them to the world. The Callimala were the bankers for the Pope and collected his taxes in England and on the Continent as a part of this exchange.

English kings, from time to time, in efforts to annoy foreign princes, forbade the export of their wool to the industries under the control of foreign princes. This vastly delighted the smugglers who infested the English Channel and the North Sea. Here we are viewing the modest birth of the English Navy. A smuggler was first of all a stout mariner. England once passed a law declaring it illegal to clip English sheep within five miles of the coast in order to put down the trade of these honest men.

Some idea of English economic acumen may be gathered from a poem, written during the reign of Henry VI, known as the *Libel of English Policy*. It expressed the sentiments of all home markets advocates, then and now. At that time, England was receiving from Spain figs, raisins, bastard wine, dates, licorice, sivill oil (olive), grain, white castile soap, wax, iron, wool, goatfel, quicksilver, etc. These were mostly Moorish products, many of them introduced into Spain during the early Moorish conquests, and came originally from Asia

Minor. In exchange, England sold her raw products to both Spain and Holland. The poem goes on to say:—

> Spain and Flanders is as eche other brother
> And neither may well live without the other,
> They may not liven to maintain their degree
> Without our English commodities
> Wool and tin: for the wool of England
> Sustaineth the common Fleming
> I understand.
> Then if England her wool restrains
> Fine cloth of Ypres—named better than ours
> Cloth of Cambria
> Fine cloth of all colors
> Much fustian (fustian: a heavy rough cloth made
> from a mixture of wool and cotton or sometimes flax and wool).
> The great substance of your cloth at the full
> Yee wot ye make it of our English wool.

The ruthless sack of Antwerp by the Duke of Parma, in 1576, had a great effect upon the textile industries of both Holland and England. This event is described in Camden's *Britannica,* of almost contemporaneous date, which describes Antwerp as, "the most excellent of cities, the most flourishing of the mart-towns without exception in all Europe."

Anderson, in his *History of British Commerce,* written in the 18th Century, says: "Much of the woolen manufacture (of Antwerp) settled in Leyden where it still flourishes. The linen removed to Haerlem and Amsterdam. One third part of the merchants and the work-

men, who worked and dealt in silks, damasks and taffetas, and in bays, says, serges and stockings, etc. settled in England, because England was then ignorant of those manufactures. And the rest of the merchants of Antwerp, more especially the Protestants, would probably also have settled in England, but that foreign merchants paid aliens, that is, double customs there, and were also excluded from all companies or societies of commerce, as were also foreign journeymen from setting up to be master-workmen or even partners in any trades but such as the English were unacquainted with.

The status of the English textile industries in the early part of the 17th Century may be gathered from an interesting experiment in the matter of industrial monopolies. In 1608, King James I issued a proclamation prohibiting The Merchant Adventures or any private dealers from shipping out of England any undyed cloths; and at the same time granted to Alderman Cockayne a patent giving him the sole right to dye and finish English cloth. On the surface, such an arrangement promised no small profits to the Crown and to the favored Alderman. The plan had only one flaw—it wouldn't work. The Dutch promptly met the situation by prohibiting the importation of any cloths, dyed or finished, from England.

The accurate Anderson says:

"Thus was commerce thrown into confusion. Cockayne being disabled from selling his cloth anywhere but at home: beside that his cloths were worse done, and yet were dearer than those finished in Holland. There was a very great clamor, therefore, raised against this new project by the weavers now employed, etc., so that the King was obliged to permit the exportation of a limited

quantity of white cloths, and a few years later, in the year 1615, for quieting the people, he found himself under the necessity of annulling Cockayne's patent and restoring that of the Merchant Adventures."

During the 17th Century the English silk industry had been vastly stimulated by the introduction of Huguenot silk workers. But there was much to be desired. English weavers still had to buy their organzines or warps from the mechanical industries of Italy. In the year 1719 (just before the memorable year 1720 and the bursting South Sea Bubble, the first English financial panic), a notice was issued to the ingenious gentleman who had obtained the necessary information from an Italian throwing mill. Anderson refers to the matter as follows: "A patent was granted to Sir Thomas Lombe, for the sole and exclusive property for fourteen years, of that wonderful machine for silk-throwing sometime before erected by his brother on the river Derwent in Derby, by mills which work three capital engines. This amazing grand machine contains twenty-six thousand five hundred and eighty-six wheels and ninety-seven thousand seven hundred and six movements which work seventy-three thousand seven hundred and twenty-six yards of organzine (warps) silk thread every time the water wheel goes round, being twice in one minute, and three hundred and eighteen million five hundred and four thousand nine hundred and sixty yards in one day and night. The water wheel gives motion to all the other movements of which any one may be stopped separately, without obstructing the others.

"One fire-engine conveys warm air to every individual part of this vast engine, containing in all its buildings half a quarter of a mile in length. The model is said to

have been taken by Mr. Lombe, from the original in Piedmont under the disguise of a common workman, he having secretly drawn its plan on paper, and then made his escape to England. These engines have saved a great deal of money to the nation, which they formerly paid for organzine or thrown silk to the Piedmontes altogether in ready money."

Parliament later granted this industrial spy £14,000 for his successful evasion of the laws of Italy.

It is also recorded that the King of Sardinia placed great obstructions in the matter by prohibiting the exporation of raw silk which these engines were intended to work.

In our own times there has been complaint that the Yankees and later the Japanese "borrowed" British cotton machinery. There is nothing new in this: since man invented new machines and tools other men have swiftly borrowed them. Ideas are earth's greatest wanderers; as a matter of record, Italy had borrowed her original ideas from Hellenistic Asia and Constantinople and Sicily.

The incident proves not only the energy of the English in the 17th Century, but also the high degree of skill Italy had achieved in the mechanical processing of silk fiber.

These scattered references indicate that the origin of British textiles does not lie in England but rather on the Continent. And to the Continent we must turn in our quest.

We, all of us, have read with interest of the careful laws of the Middle Ages protecting the public, or as we say, the consumer, from the wiles of manufacturers and merchants; and there are those who still may sigh for

those happy days when Governments assumed these responsibilities. As literary essays, and in theory, I honor those laws, but I also imagine that the eloquent preacher, Berthold of Ratisbon, in the year 1246, knew more about the facts of the case. His recorded remarks lack enthusiasm, to put it mildly:

"Ye that work in clothing, silks or wool or fur, shoes or gloves or girdles; men can in no wise dispense with you; men must needs have clothing, therefore, should ye so serve them as to do your work truly; not to steal half the cloth, or to use other guile, mixing hair with your wool or stretching it out longer, whereby a man thinketh to have gotten good cloth, yet thou hast stretched it to be longer than it should be, and makest a good cloth into useless stuff. Nowadays no man can find a good hat for thy falsehood; the rain will pour down through the brim into his bosom. Even such deceit is there in shoes, in furs, in skins; a man sells an old skin for a new; and how manifold are your deceits no man knoweth so well as thou and they master the devil. . . . Thou, trader, shouldst trust God that He will find thee a livelihood with true winnings, for so much hath He promised thee with His divine mouth. Yet now thou swearest so loudly how good they wares are, and what profit thou givest the buyer thereby; more than ten or or thirty times takest thou the names of all the saints in vain—God and all His saints—for wares scarce worth five shillings! That which is worth five shillings thou sellest, maybe, sixpence higher than if thou hadst not been a blasphemer of our Lord. Ye yourselves know best what lies and frauds are busy in your trades!"

The tangled skeins of European fabric history lead back through the cities of northern France, of Flanders

and of Holland and at last to the great Italian trading Republics; and, to a lesser degree, to Southern Spain under the beneficent influence of the Moors. The velvets of Genoa, the gold and silver brocades of Venice, the fine wools and silks of Florence, were as prized in the European commerce of those days as they are in the museums of our own times. But, again, Italy is not a source of origin. It is merely another center of distribution: another place where commerce inspired industry and industry became an art. There is no question that Italy taught Europe the arts of the loom and the dye-bath. But the question is, who taught these arts to the Italian masters?

Our narrative shifts once more to the great city of Constantinople, once the head of the Eastern Roman Empire, and to the islands of the Eastern Mediterranean; and indirectly to the still more ancient trade and industrial city of Alexandria in Egypt, founded after the death of Alexander of Macedon. Italy and Genoa became the trade agents for Constantinople in the markets of Europe, and since trade is the Mother of Industry, began, in the early centuries of the Middle Ages, to develop her own industries and arts based on her observations made in Constantinople.

Let us glance for a moment at Sicily, the Island which lies directly between Italy and Constantinople on the old trade route. Since the times of Justinian, this island had been under Byzantian, Arabian and Norman sovereignties, and had known something of Austria, Anjou and Aragon as masters. Under Roger II, the Norman, in the year 1147, silk weavers, dyers and farmers were introduced into Palermo as a result of worthy Roger's conquests of Corinth, Thebes and

Athens, which cities were, at that time, centers of the Hellenistic silk industries. From Sicily, a century later, the silk industry, moving as usual on the roads of conquest, came to Lucca, and, ultimately, to other Italian cities. The 13th Century saw a great development in the Italian silk industries. The Mongol hordes had fallen upon Persia and crushed this ancient center of textiles into the dust. In the year 1204, the armies of the Fourth Crusade, led by Venetian treachery and selfishness, had stormed the triple walls of the Christian city of Constantinople, instead of rescuing the Holy Sepulchre in Jerusalem from the Turks, and had turned the great Empire of Byzantium and the prosperous markets of Constantinople into Venetian trade monopolies. But, in spite of these advantages, it was not until 1440, thirteen years before the Turks captured Constantinople, that mulberry trees were seriously cultivated in Italy. Before that time, the eggs were imported from Greece and the Levant and fed with leaves imported from Greece. This does not indicate a very large development in the silk industry in Italy, but it proves the dependence of the Italian industries on Hellenistic Asia, Greece and Asia Minor.

In the middle of the 13th Century, there occurred an event of the greatest importance to the woolen industries of Florence, and later to those of Europe, based upon the Florentine examples. The Humble Fathers of St. Michael of Alexandria (the Humilati) removed themselves and their knowledge of spinning, weaving and wool dyeing from the ancient city of Alexandria to the rising mistress of the Arno. From the vague technical accounts of this event, I am inclined to believe that the good Fathers brought with them a somewhat

more intricate form of the Oriental loom and also the Indian spinning wheel and an intimate knowledge of the dyes of antiquity and the arts of dyeing. Curiously enough, there are records of fulling mills in Florence a century before this time. There is reference to an organized woolen trade in Lucca as early as May 10, 846, and documents to prove an association of wool workers in Florence in 10th and 11th centuries including fulling mills, wool dyers, cloth pressers and sheep shearers. But Alexandria had possessed a woolen industry from at least the 2nd Century when dyers and fullers and weavers are mentioned. They brought to Florence a superior technical knowledge, not a new industry. But the great teacher of Italy's industries was the City of Constantinople.

From the 5th to the 11th centuries, Constantinople was the center of world trade connecting Europe with Asia, Asia Minor, Africa, and even with Russia and Scandinavia. It was the first, and among the greatest, and certainly the most cosmopolitan of all European cities in the Middle Ages. It was a market of world luxuries. These luxuries gathered from the trade centers of the world, inspired luxury industries, not only in Constantinople, but in the cities of the great Byzantine Empire which she controlled. Constantinople had, in the 9th and 10th centuries, a population estimated at 800,000, and the income of this city alone, from her tariffs, exceeded 7,300,000 bezants or $21,000,000 in modern money, not allowing for the great differences in the purchasing power of gold between the 10th and 20th centuries.

The superlative achievements of Constantinople in fabrics does not rest, fortunately, entirely on literary

records. There are still surviving precious documents in our museums which amply attest the great beauty of these fabrics and the exquisite technologies of Byzantine workmanship in linens, wools and silks. She was the school teacher of Italy and the Mother of later European fabric arts. But, again, the question arises, who taught Constantinople? And, again, the trail leads us towards the East, pausing briefly in the land of Egypt. From ancient times, when the Pharaohs were the Lords of the Nile, there had been commerce with the East, Persia, India and the coast of Africa through the Red Sea. In the 1st Century of our era, Hippalus, a Greek navigator, discovered the carefully guarded secret of the Arabian and Hindu pilots of sailing back and forth on the recurrent monsoons. Immediately following this discovery, an unknown but not unworthy Greek Merchant wrote the first European trade account, the *Periplus Of The Erythraean Sea.* In this account are mentioned towns and the distances between towns, the nature of the rulers, and the people and the kinds of merchandise saleable in those towns or which might be found by merchants in those markets. Silks, cottons, aromatic gums, glassware, elephant teeth and spices are mentioned in this account. In other words, the same kind of merchandise for which Constantinople was to be famous 500 years later, were already known in the ports of the Red Sea.

I will quote one other document in this respect to prove the antiquity of the trade upon which Constantinople and the Italian cities in turn rose to greatness and wealth. My authority is "Revelation," and the quotation refers to the burning of Rome, although the name Babylon is substituted for Rome for obvious reasons: "And the Kings of the earth shall bewail her and

lament for her when they see the smoke of her burning and the merchants shall weep for her; for no man buyeth their merchandise any more. The merchandise of gold and silver and precious stones and of pearls and fine linen and purple, of silk and scarlet and of sweet wood and all manner of vessels of ivory . . . odors and ointments and frankincense and wine and oil and fine flour . . . and sheep and chariots and slaves and the souls of men." "Alas, alas, that great city wherein were made rich all that had ships in the sea by reason of her costliness . . . for thy merchants were the great men of the earth."

These gloomy prognostications were by no means justified by subsequent events. Rome was rebuilt on a grander scale and the merchants did a great business. But, again, their business was in products either from the coast of Africa, the islands of the Indian Ocean or the Far East.

If we are to find an origin for "Textiles," we must leave not only Europe and the classical world, but also the world of Bible History, and seek for origins with the anthropologist and the pre-historian in the Near and Far East.

But, one word more to prove this necessity: The dyes used in Italy, in Byzantium and in Alexandria were more ancient than even these ancient cities. First among these dyes was murex, the distilled essence of the decayed flesh of a Mediterranean shell fish which was known to the Cretans at least 2,000 B. C., and on the mainland of Asia Minor, earlier. There is an Egyptian poem, dated 1,400 B. C., which refers with inelegance to this dye in the following line:

"The hands of the dyers stink with putrid fish."

It is from this substance that the famous Tyrean purple was obtained; the purple known to Roman emperors, knights, and senators, and worn by Roman generals when given a Triumph. Somewhat later this color became the favorite of His Holiness, the Pope.

The reds were produced from the ancient madder plant, which was known in commerce down to the latter quarter of the 19th Century, and was (in colonial times) grown in North America for the markets of Great Britain.

The famous scarlets, which appear in the Coptic fabrics of Egypt, and which in turn became the Cardinals' color, were from the dried bodies of a tiny Persian insect, known in the Middle Ages as kermes. The Romans, believing these tiny specks to be dried berries, called them "coccunum" and the linguistically conservative English in the later half of the 19th Century referred to them as "Persian Berries." But the dyers of the Middle Ages translated Kermes (Persian for little worm), into the Latin "vermiculata" and from this Romanized "little worm" the French name for the color vermillion was derived.

Indigo was first mentioned in a European language by Herodotus about 450 B. C., and it is, of course much more ancient. Indigo plants are found all over the world. They were not superseded by a chemical substitute until the turn of the present century.

In the New World, far beyond the influence of any possible contact with the Old, a species of murex was used by the ancient Aztecs, Mayans and Peruvians to produce purple and is still used today by the native dyers of Yucatan.

The famous cochineal of Mexico is a female insect

living on the leaves of the cactus plant. It was brought to Africa and the Near East in the 16th and 17th centuries where it apparently replaced the still more ancient kermes. Up to the middle of the 19th Century, the dried bodies of the female cochineal insects were quoted in the advertisements of New York papers. In 1877, over a million pounds were imported into the United States. Cochineal was used to dye the jackets of the British Red Coats. Before the Napoleonic war, the price of these insects was about 4 Shillings a pound, but just before Waterloo the price rose to 30 Shillings, but fell a few months later to 4 Shillings a pound.

These dyes and others of a similar nature are of great antiquity in both the Old and the New World and they survived in commerce and in industry up to the time of the invention of synthetic dyes which began in 1856 with Perkin's indanthrene purple taken from coal tar. None of these earlier dyes are European in origin. **As a matter of fact, Europe has never produced a single original natural textile fiber or any dye except, perhaps, woad. She has not contributed a single fundamental or original idea to the basic mechanics of textiles, nor a single original and fundamental process of finishing, dyeing or printing.**

To these general statements, I must make two important exceptions: In the latter decade of the 15th, or the first decade of the 16th Century, that universal mechanical genius, Leonardo da Vinci made a draft of a spinning device known as the flyer. This device, fifty years after his death, was reproduced in the Leipsig spinning wheel by a German wood-worker. Most of us are familiar with this incredible mechanical invention in the little wooden horseshoe, studded with wires, which

is a distinguishing feature of the smaller spinning wheels so dear to hearts of antiquarians. This device was later adopted as the principal feature of Arkwright's spinning machine and is part of the equipment in most textile spinning mills in the world today. It is an entirely original invention. It is the first continuous movement in modern textiles.

The other spinning devices of the 18th Century in England, Hargreaves' spinning-jenny, and the mule of Crompton, were undoubtedly derived from the spinning wheel of India, which does not contain the flyer I have mentioned. All that we have done to the loom of India is to apply power and make its movement automatic. But here, again, I must make a slight exception. In the year 1734, at the very dawn of the Industrial Revolution, John Kay, a weaver of Bury, added what is known as the fly shuttle to the ancient Oriental loom. This was a device of strings and rods and movable blocks of wood which made it possible for a single weaver to throw a shuttle through an open shed of warps and weave a broadcloth without the aid of assistants to throw or catch the shuttle. This device increased the productivity of the loom at least four times. It was the first important addition to the loom in thousands of years of usage. Kay's reward was to be driven from England by outraged labor and to die in a Parisian garret.

In the broader world history of textiles and cloth, the ingenious English inventions of the 18th Century (led by Kay's fly shuttle) are but incidents, mechanical modifications and developments, of older ideas which grew out of the social conditions in England, and were indirectly due to the importation of cotton and silk fabrics from the Far East during the 16th and 17th

centuries. No new basic principles, either of spinning, weaving, or fabric construction; methods of decoration, dyes, colors or designs, are involved in the English machines. The ancient principles of twisting and elongating masses of fiber into yarn, the principle of interlacing one set of filaments held in place between parallel bars with a second set of filaments, remain undisturbed. No new raw materials are involved: flax, hemp, wool, cotton and silk still remain the principal fibers. And for color the dyes of antiquity were still employed. As a matter of fact, all the dye raw materials of antiquity, both from Asia and the New World, are still mentioned in English dyers' manuals in the late part of the 19th Century and years after Perkin's experiment with coal tar derivatives in 1856. Among the exotic dye-stuffs mentioned are Murex (shell-fish purple), Madder (vegetable red), Kermes (Asia Minor), Cochineal (Mexico), Logwood, Campeachy wood and many others.

The one factor of true invention in this period occurs in the last quarter of the 18th Century when the new mechanical devices and new methods for applying the ancient principles are placed in a serial relationship to each other, driven by water and later by steam power and made more or less automatic in operation. The modern factory is the great economic and industrial feature of this period; and, while even the factory for mass production by division of labor has parallels in the past, this is the first time that a combination of artificial power, division of processes, and specialization in human labor, rose to a dominant position in the production of certain standard types of cloth.

Kay's fly shuttle (1734), was the first addition to the Oriental loom made by western ingenuity. It made it

possible for a single weaver, without any assistance, to weave a broadcloth, that is, a cloth wider than a man could stretch his hands to cast and catch a shuttle. It increased the productivity of the loom three or four fold, and, consequently, reduced the cost of weaving and the price of cloth, as this price was affected by the earnings of the weaver. But it upset the mechanical balance between the supply of yarn and the capacity of weavers to convert yarn into cloth. In this manner it created a "necessity" for a greater supply of yarn or an increase in the productivity of spinning methods.

Weaving had become, to a certain extent, a professional or full time vocation. There were even groups of weavers working for employers who supplied yarn, paid wages, had the cloth fulled and dyed and sold the finished fabric in the open market. There were, of course, independent weavers who bought their own yarn or whose families spun their yarn, and who sold their unfinished cloth either to dyers, and fullers or to merchants.

But spinning was a by-industry of the homes. It is estimated that in England 25% of the cash income of the cottage farmers was earned by the home spinners, who used either the spinning wheel of India, or the spinning wheel to which Leonardo da Vinci's spinning flyer had been adapted. For centuries there had been a relationship between the amount of yarn that could be secured from such sources, and the capacity of the professional looms to convert this yarn into cloth. Since the 16th Century there had been a gradual increase in the supply of yarns of silk and cotton imported from the Orient to be woven in the Occident. But the supply of yarn and the capacity to convert yarn into cloth had reached a certain equilibrium.

As soon as Kay's invention was generally adopted by the weavers, the unbalanced relationship between the supply of yarn, and the capacity of weaving, was apparent. The merchants who controlled the professional weavers, and the weavers who were independent workers, were faced with a scarcity of yarn and the rising cost of yarn. This long generation was a period of temporary prosperity of the home spinners. During this period there are great complaints about the cost of yarns and the inability of weavers to get an adequate supply. The weavers often had to pay a large part of their earnings to the spinners and devote a large part of their time to collecting yarn from the farms and cottages of England. This fact accounts for the bitter opposition of the rural classes to all later spinning inventions.

But this situation created an economic condition, peculiarly favourable to new inventions to increase the productivity of the home spinners. New inventions move against all social opposition. It is a significant fact that after 1734 (Kay's invention), no new loom invention occurs until the theoretical power loom of the Reverend Edmund Cartwright in the year 1785. But this invention was of no use until Radcliffe and Ross (1803–4) invented a machine to impregnate the warp yarns with starch in order to make them strong enough to stand the stress of power loom weaving. The power loom did not become a factor in the economic life of England until after the turn of the 19th Century and it did not appear in America until 1813, when a single power loom, copied from an English model, was set up in Waltham, Massachusetts. In 1820, there were 14,000 power looms in Great Britain and 55,000 hand looms.

But between these two dates of weaving (1734–1785)

occur the inventions of those spinning machines, which are now the basic factors in all modern power driven textile mills. The first of these inventions involved the use of two or three sets of rollers revolving at different rates of speed which drew out masses of fiber into rovings or partially fabricated yarns. The patent for roller spinning was taken out by Louis Paul in 1738; but the invention is generally attributed to John Wyatt. The next invention (also attributed to Louis Paul), was the circular card for preparing fibers for spinning by laying them parallel to each other and cleansing them from foreign matter. These two inventions were obviously intended to relieve the home spinners of much preparatory labor, and leave them more time for the final spinning of the fibers into yarns for weaving.

These inventions were merely factors of convenience for the home industry of spinning. In the year 1767 James Hargreaves, a weaver near Blackburne, produced the first machine for spinning with multiple spindles. His famous spinning-jenny made it possible for a single worker to produce at first twenty-four, and, later, seventy-two yarns at the same operation. This is the first example of mass production in the textile industries. Labor did not protest against the jenny with twenty-four spindles. This seemed to them a home implement; but they invariably broke up all spinning-jennies which had seventy-two spindles whenever they discovered them in operation. This spinning-jenny got to America at least as early as 1775. A picture of such a machine is shown on a stock prospectus of a woolen mill in Philadelphia in the year 1775 to manufacture woolen cloth for the expected American Revolution. It was used to prepare rovings to be distributed to home spinners. Such a machine was men-

tioned in Beverly, Massachusetts, and was seen and admired by both Washington and Hamilton in 1788.

These three earlier inventions, roller spinning (1738), circular card (1748) and the spinning-jenny (1767), increased the production of yarns, and, therefore, placed a premium on the services of the professional weaver. By 1770 the weaver became a very prosperous individual and almost all of the cottages in the midlands of England were enlarged so as to include space for one or more hand looms with Kay's fly shuttle.

But, by this time, the merchants who already partially controlled the production and sale of cloth had engaged their energy and capital in the merchandising of yarns. When they discovered that there was a surplus of yarn in England as compared to England's capacity to weave these yarns into cloth, they began to sell the surplus yarn to the hand loom weavers on the Continent, who, at that time, worked on a lower level of wages than the English weavers.

The principal inventor of this period, and the prototype of the modern industrialist was Richard Arkwright, an itinerant barber of the midlands of England, who became interested in textile machines. His famous water frame was the first machine to spin by mechanical method cotton yarns strong enough to be used as warps. All of his patents were ultimately denied by the British Court and the decision of this court in 1785 has been more than sustained by subsequent investigation. Arkwright's "invention" was not a machine but a system. Arkwright received his first patent for his famous water frame in the year 1769 but it was not until the year 1774, with the aid of a partner, Jedediah Strutt, that his first factory was ready for operation and prepared to usher into the

world the modern phase of machine made textiles produced by automatic power driven machines. His factory was a spinning mill and its products were warp yarns suitable for weaving coarse cotton cloths. He immediately found himself in legal difficulties. Ever since the dawn of the 18th Century, the English textile industries had opposed the importation of silks and calicoes from the Orient, and, in 1720, an Act of Parliament prohibited the use or wear in Great Britain in any garment or apparel whatsoever of any printed, painted, stained or dyed calicoes under the penalty of forfeiting to the government the sum of five pounds and by the same Act the use of printed and dyed calicoes in beds, chairs, cushions, window curtains or any other sort of household stuff or furniture was forbidden under a penalty of twenty pounds and the same penalty was attached to the seller of the article. The Act went so far as to forbid the use of any printed or dyed goods of which cotton formed any part, so that the goods made of linen warps and cotton wefts could not be used in a printed or dyed state. Calicoes dyed all blue, as well as muslin, neckcloths and fustians, were excepted from the prohibitions of this Act.

But Richard Arkwright and his partner were business men, familiar with the methods of approach to parliamentary committees. And so by the Act 14, George III, C-72, these limitations on the development of a new industry were removed. And, thus, the manufacture of cheap, coarse cotton goods was introduced into England and later from England into the world.

In the year 1844, Edward Baines published his "History Of The Cotton Manufacture in Great Britain," one of the most intelligent works ever produced on this interesting subject. He says in part: "At the beginning of

the reign of George III. (in 1760), probably not more than forty thousand persons were supported by the whole cotton manufacture: machines have been invented, which enable one man to produce as much yarn as two hundred and fifty or three hundred men could have produced then, which enable one man and one boy to print as many goods as a hundred men and a hundred boys could have printed formerly: and the effect has been, that now the manufacture supports fifteen hundred thousand persons, or upwards of thirty-seven times as many as at the former period!"

In 1760 England imported 3 million pounds of cotton wool. By 1833 England was importing over 300 million pounds of cotton wool. Today England's imports of cotton lint are estimated in billions of pounds.

The fine yarn cotton business was brought to England by the invention of the spinning-mule of Samuel Crompton which was perfected in the year 1779. Before the invention of the mule, the fine cotton yarns had been imported from the hand spinners of India. These yarns were used in the manufacture of sheer, light-weight cotton goods known at that time as muslins and cambrics.

The count of a cotton yarn is estimated by the number of hanks of 840 yards each, contained in a pound. The influence of the mule may be estimated by the reduction in cost of these fine-count yarns between the year 1786 (seven years after the invention of the mule) and the year 1832, when the mule was thoroughly established in English mills. The price of the #100 yarn in 1786 was 38 shillings per pound. In 1832 this price had shrunk to 2 shillings and 11 pence per pound.

The invention of the cylinder printing machine by Thomas Bell in 1775 made it possible for England to ex-

port not only to Europe but to India printed goods and was one of the most important factors in the development of England's exports of cheap cotton goods.

It is an incredible fact that the early developments of these machines, which had so powerful an influence, not only on the world wide production of textiles, but which have so vastly changed the map of the world's raw commodities, and have increased the wealth of the world to such an incredible extent, were practicaly unnoticed in their earlier forms by either English economists, writers or politicians. Adam Smith's "Wealth Of Nations," published in 1775 (the year after Arkwright's first factory), contains only a short paragraph on cotton manufacturing. I have mentioned the disenabling legislation which had to be repealed before Arkwright's first modern factory could get under way.

This period of history is filled with the records of machine-breaking riots, often encouraged by the ruling classes, but, ultimately, stopped by legal measures which made machine breaking a felony and punishable by death. It is darkened by the records of the most incredible stupidity and cruelty in the management of labor, and is one other proof, if such additional proofs were necessary, of the ineptitude and lack of vision of government and of society at large when dealing with new and revolutionary factors of inventions.

This period of industrial and mechanical evolution deserves the most serious attention of research scholars. Our picture of these times, while filled with detail, is not yet as clear and as lucid as we might wish. But it is, as I have said, only one phase in the general history of cloth making, one more enigma still waiting final solution. For the basic history of cloth we must now turn from the

historian, politician and economist to the anthropologist and the archaeologist for a further grist of facts.

The earliest known fibers spun by man are the group known as bast. They consist of the stalks of various grasses, leaves, barks and vines from which the non-fibrous parts have been rotted out and the remaining vegetable skeletons broken up into fibers, more or less fine, by pounding and rubbing or by dragging the mass over sharp points. Our verb "to heckle" comes from this process and is a highly descriptive term. Hemp, jute, ramie and coir are all basts, but the best known of this group is flax, the fiber from which linen is made.

There is no tribe on earth today, no matter how low in other forms of culture, but spins excellent cords, often for a great variety of uses. Most of these cords belong in the bast group since raw materials of this kind are almost universal. Bast, according to all historic and ethnological evidence, is more ancient in culture, as in date, than wool or cotton or silk.

The most ancient fabrics so far discovered belong, as might be expected, to pre-dynastic Egypt, and the cultures which underlie the great epochs of Egyptian civilization. They are of flax as far as can be determined from their condition of decay. The dates given for this period extend back to 8,000 B. C. There is evidence of a loom frame and the fabrics include several varieties of plain weaves. Since the same culture includes eyed needles of bone and copper, painted pottery, barley and wheat, organized community life, domestic cattle and sheep and ritualistic burial customs, it can scarcely be described as Primitive in the true meaning of that term. Moreover, none of these culture factors are native in a wild state

in the valley of the *Nile;* hence, they are intrusions from still earlier and less advanced cultures.

No woolen yarns or fabrics are found in these graves. There may, of course, have been some ceremonial reasons for this exclusion. The absence of design in linen fabrics suggests the absence of color in cloth, since design and pattern are technical devices to distribute color. Flax, even today, is not easy to dye. The Egyptians no doubt satisfied their love of color in less inducible media. It is not until after the Christian era and the Hellenistic Asiatic intrusions that colored fabrics appear in Egyptian graves and then the colored elements, with rare exceptions, are either of wool or silk.

An almost equally ancient record of flax occurs in the silt of the Swiss Lake Villages relic beds. An unusually dry summer in the middle of the 19th Century revealed the remains of villages built upon spiles which, layer by layer, date back from Roman times and the last Age of Iron to an almost pure Neolithic culture of polished stone implements. In the earliest village site of Robenhausen (about 5,000 B. C.), have been found a number of rather complicated fabrics woven from flax yarns and also fish lines and nets and bow cords and a rudimentary type of single-barred loom, associated all over the world with the weaving of fabrics of flax or coarse wools. Here again occur the bones of sheep in large numbers, but here, as in Egypt, there is no evidence of woolen cloth.

The earliest examples of woolen fabrics found in Europe are a few garments of men and women buried in hollowed oaken logs in bogs of Scandinavia and belonging to the first Age of Bronze, or about 2,500 B. C. Dr. MacCurdy refers to this cloth as similar to the fabrics worn

today by the peasants of the Scottish Islands or, in other words, an early form of tweeds. Descendants of Neolithic sheep are still grazing on those ruggard islands.

Since the Neolithic and Bronze cultures are intrusions from the East into the West, even these early fabric arts are not native in origin within the geographical limits of Europe.

Wool has a more ancient background outside of Europe. In Tepe Gawra, or the Great Mound, in Asia, at the eleventh level of twenty buried cities of sun-baked bricks, have been found evidences at least of the presence of sheep. These evidences include seals bearing rams' heads, which strongly imply the individual ownership of sheep and perhaps of wool and even trade in sheep and wool. Somewhat more complete evidence lies in a covered pot containing the bones of the most venerable lamb stew in history. Mr. Jonathan Johnson, describing this discovery, says: "In the sixth millennium, B. C., a migratory horde swept from the East over India, Persia and Mesopotamia. Many more waves of invasion were to break over the hills and valleys of these lands; it is not even likely that this was the first. But we still know so little about the early movements of man in Mesopotamia that we cannot say whether any race was there to receive this horde, for wherever their remains have been found, they lie at the bottom of all other identifiable human remains."

These people produced a fine type of painted pottery and are called, for want of a more descriptive name, "Painted Pottery People." They lived in organized cities, were herders and farmers and have left evidences of their culture in Susa (Persia), Baluchistan, Southern Russia, Nineveh, Northern Mesopotamia, Ur and Babylon. When

we know more of this far-spread culture, we will know more of the early history of wool. This is the proper region to seek for beginnings for the sheep from which most modern breeds are derived, a breed known as argali, are believed to have originated in central Asia not far from this great mound.

The date of the seals and the lamb stew referred to is 4,000 B. C., or thirty centuries earlier than the fall of Troy, or 6,000 years before this writing.

Up to a few years ago, the most ancient cotton documents were from pre-historic American graves. In my own collection is a fragment of a ceremonial apron from Grand Gulch, Utah, with a possible date of several centuries before the Christian era. The damp soil of most Indian graves, and the ravages of the white ants have destroyed the earlier Asiatic records. Reliance was placed formerly upon literary records and the firm belief that human society was more ancient in Asia than in the New World.

Of recent years this faith has been justified. In the ruins of Mohenjo-daro, a city in the Indus Valley, deserted in or about 3,000 B. C., was found a silver vessel. In the handle of this vase, preserved by the oxidization of the metal, was found a precious fragment of loosely woven cotton cloth about 1/10 by 3/10 of an inch in expanse. This is all the ages have left of the bag which once contained the silver vessel. In addition to this, two bits of yarn, one 12- and the other 24-ply, were found in pottery shreds. The evidence is scanty but still adequate to establish cotton as at least as early as 3,000 B. C. in the valley of the Indus.

The city of Mohenjo-daro had a water supply, and a drainage, if not a sewer system. The people were skilled

agriculturists or they could not have cultivated cotton. Other evidences of their cultural status lies in the knowledge of domestic animals and wheeled vehicles and the use of silver. Silver in the Old World is seldom found in a pure state. It had to be reduced from oxides and, next to iron, it is the last metal smelted by man.

One of the major mysteries of pre-history lies in the presence of cotton both in ancient Asia and in ancient America. No other common cultivated plants occur in these regions before the 16th Century. Cotton and the conversion of cotton into yarn and cloth by identical methods into almost identical techniques strongly suggested sustained cultured contacts between these remote areas at some indefinite time in the past. All negative evidence was, and still is, against this assumption of culture contacts between Asia and the Americas except the contact between Siberia and Alaska. Cotton could not have played a part in this arctic point of contact. Yet here were cotton and cotton techniques both in southern Asia and Peru. This enigma has been, in part, cleared up by the knowledge that the cotton of the Indus Valley and the cotton of the New World do not, strictly speaking, belong to the same species, although both bear the common name of gossypium. In the seed cell of the Asiatic type, there are 13 chromosomes; in the American type there are 26: Fertile hybrids are impossible. This apparently suggests that one type could not have been derived from the other. The matter of intrusion is, of course, by no means entirely settled. All such problems depend upon further discoveries. But at least the presence of cotton plants in the two areas has ceased to have its former significance. So far as human culture and invention are

concerned, they are different raw materials. It is a problem for botanists, not anthropologists.

Some technical explanation of the similarities in spinning and weaving in these areas may still further clear up lingering doubts about mysterious migrations across the Pacific and the Island of Mu. The cotton lint differs from the earlier basts and wools in its shortness (primitive cottons do not average over an inch in length), in its finer diameter and lack of strength of individual fibers.

In both India and in the ancient textile cultures of Peru, early technicians solved the problems of cotton-spinning in the same way. This problem was how to control vibration. In both regions, the solution lay in resting the point of the spindle on some smooth surface to reduce oscillation, and hence vibration, and to twist the other end of the spindle with the fingers of one hand while twisting and drawing out the yarn with the other hand. I have described this method elsewhere as the bobbin-and-bowl method.

In the New World, this method was never changed until modern times and is peculiar, with the two-barred loom, to the cotton area. But India was in direct contact with the regions and peoples who produced the wheeled chariot. She apparently borrowed the wheel from the chariot and turned it into the spinning wheel. So the matter rested for thousands of years until Leonardo da Vinci added his flyer, which, as I have said, was first applied to the Leipsig spinning-wheel and later was incorporated in Arkwright's famous water-frame. In other words, there is a perfect technological sequence from the time (perhaps 3,000 B. C. or earlier) when some spinner in the Valley of the Indus rested the tip of her spindle in

a bowl of water and twisted these delicate seed-hairs in a gossamer filament, to the great mills of today with millions of spindles revolving 10,000 times a minute and converting billions of pounds of lint into yarns for the world's hungry looms. That this same basic idea of bobbin and bowl spinning should have occurred twice, once in India, and once in Peru, only increases the miracle.

In India and the New World, the older looms are simply two parallel bars which keep the warp threads parallel to each other and at a proper degree of tension. To this simple arrangement, Peru added a light rod to which alternate warps were attached in order to lift the threads for the insertion of the weft. This is as far as Peru ever advanced in loom type.

To this simple loom India added foot treadles, and Persia and Europe ingenious devices for mechanical pattern-weaving. John Kay's flying shuttle was Europe's first European addition to the loom, and within the same century, Cartwright's power loom appears. Today, due to an American invention, the Draper Loom, perfected by Northrop, a British mechanic, weavers can take care of more than 100 looms each shooting from 140 to 180 picks of weft per minute. But these looms are in principle still the looms of the ancient Indus Valley and the Peruvian deserts and the cotton area of the New World.

H. G. Creel, in his admirable work, *The Birth of China*, places silk in the Shang culture about 1,400 B. C., and reasonably assumes fine tailored clothing with sleeves from the delicately carved ornaments and buttons drilled with holes to be sewn on garments and the presence of eyed needles in these culture sites. This is the most remote date of scientific reliability for silk. The Chinese records of greater antiquity are largely myths. The

Shang culture possessed walled towns, a form of writing, still partly decipherable; made beautiful vessels of bronze and possessed the potters' wheel. They had horses, pigs, sheep, goats and oxen. They cultivated wheat and millet and made a kind of beer from the latter grain. There is even some evidence that they cultivated rice and practiced a rude system of irrigation and also grew a kind of hemp. In tombs only a little later than the Shang, silk worms carved out of Jade have been found and an inscription on a bronze vessel of the 9th or 10th centuries B. C. records the use of silk as a medium of exchange in the purchase of slaves.

The Shang culture, on the records, must be regarded as an early type of civilization rather than an advanced stage of culture. They used cowrie shells for money, had merchants and drug peddlers, a ruling class and oracle readers; chariots with which they made war against the western peoples to get slaves to work their fields and tend their herds and also for human sacrifice. These accomplishments entitle them to high consideration and teach us a respect for their civilization since it so nearly resembles our own. The Shang date of 1,400 B. C. for silk is by no means the date of origin of silk, but, like flax and wool and cotton, the earliest date for the appearance of silk upon which we can rely.

There is, of course, a still older form of silk than the continuous filament of the cultivated cocoon. When the Chinese merchants and adventurers made their way across the deserts of northern Asia and arrived in Persia, about the 2nd Century before our era, they recorded the fact that these western barbarians did not know cultivated silk but did know the silk fiber shredded from the pierced cocoons of the wild moth, or tussah silk. It would

be difficult to attempt to date such a product as tussah; it may be older than wool and certainly is technically older than cotton.

The organized trade in cultivated cocoon silk between China, Central Asia, and ultimately the coast of the Mediterranean, begins in the early Han dynasty or about the 2nd Century B. C., and to the energetic Emperor Wu-ti the credit is due for this great movement. As I have observed in another part of this book, it was in the Han dynasty that China received glaze from Arabia and Egypt and began those ceramic processes which led in time to porcelain. At this time, China had some indirect trade connection with Arabia through the port of Ceylon. China decided to seek a land route under her own control rather than submit to the exactions of the various middle men who controlled the ports of the Indian Ocean, the Red Sea and the Persian Gulf. The extension of a caravan route through the Tarim Basin across northern Asia's bitter deserts and into Central Asia was a stupendous undertaking. After 2,000 years, this route is still in use, although fallen upon evil days. Yet men can still mark by ruined cities and the bleached bones of camels and of men those ancient roads of silk and beauty.

These roads, or rather these narrow tracks, winding for thousands of miles across Asia, were as important to world civilization as the ocean route to India sailed by Vasco da Gama some seventeen hundred years later. I have already commented upon the great exchanges of ideas and wealth between China and Persia, between the Christian Era and the 13th Century, or when the Ming dynasty expelled the Mongols and closed China to the world's merchants. These early trade contacts gave to the classical Near East such terms as "seric garments,"

"seres," etc., which became in time the modern word "silk" and also "serge," now a worsted cloth; and, curiously enough, "denims," a name applied to a stout cotton fabric which was once "serge-de-nimes," meaning a fabric of wool and flax woven in the ancient city of Nimes, in southern France, imitating, no doubt, a more ancient fabric of silk.

The memorable expeditions of Sir Aurel Stein, in 1913–16, in the ruined cities of Lou-Lan and Turfan, and the Kozlov Expedition, in 1924, in the Sythian tombs near Lake Baikal, have revealed to us some knowledge of ancient Chinese silk and also of the extent of this ancient caravan trade. These fabrics include examples of silk gauze, technically similar to the gauzes in the hair-wool and cotton fabrics of Peru. Both of these widely separated techniques were derived from the more primitive twined weaves and both are related to almost universal basketry types. It is curious how two widely separated peoples should have reached techniques so similar.

There is space only for a single example of how widely a stirring design may spread both in space and in time. Among the documents which Kozlov brought back from the tombs of Lake Baikal was a quilted and embroidered fabric of silk depicting a mythical winged feline, perhaps a Siberian tiger, attacking a reindeer. The Sythian nomads, wandering about Asia, sometimes robbing, sometimes acting as mercenary soldiers, and sometimes even conveying caravans, came in contact with the Chinese in the East and the long established civilizations of central Asia and Asia Minor in the West and constantly borrowed or stole not only tangible forms of wealth, but ideas, and perhaps even craftsmen to execute them. This design, even in its latest form, was far beyond their own

imagination. It has been associated with the famous Lion and Bull motive of the times of Shalmenser and goes back to the Chaldean era or about 3,000 B. C. It was a symbolical design representing the Spring equinox festival of sacrifice to Mithra, the Sun God. This was the time when the envoys of the tributary Nomadic people arived in the Assyrian capital. The Sythians in time forgot all about Chaldean bulls and lions and the Spring equinox and transferred the form of the design to animals with which they were familiar.

The earlier Chinese decorated fabrics are often described as "brocades." I am inclined to regard them as needle-work. No doubt they were made on a loom, but the needle rather than the bobbin was used to insert the decorative element. The needle also played an important part in the intricate fabrics of Peru and the same mistakes were formerly made in their description. The pattern loom, in my judgment, is a product of Persian invention based upon the early cotton loom modified to fit the desires and opportunities for color presented by word and silk. But the needle, as I have said, was a very early and important factor in Chinese culture.

Persian gold brocades, obviously loom work, were well-known in the times of Xerxes and are mentioned by the historians of Alexander the Great of Persia. Persian brocades were sent to the Emperor Wu as tribute or trade gifts in the year 520 A. D.

It seems significant that the Chinese explorers of the 2nd Century B. C. refer to Persian brocades as needlework. In other words, they described Persian loom work in terms of the needle, an implement familiar in China. This is negative evidence that the pattern loom was at that time unknown in China.

The Chinese designs were not acceptable to Persia and the Near East. But the fine, brilliant, white silk was most desirable since it took color with such fine effects. The Chinese comment upon the fact that the western barbarians knew the wild or tussah silk but not the cultivated variety. This older silk had, and still has, a strong brown cast because of the tannic acid present in forest leaves upon which the caterpillars of the wild moth feed.

There is an evident relationship between silk and wool in the Near East and Egypt. The wool dyes of the Near East were successfully applied to silk, since both are of animal substance. The colors and dyes of China had apparently little effect upon the colors of silk wrought from Chinese fiber in the West.

There is a present gap in the history in the Near East not only of silk, but of wool, and of the loom, which can only be filled by patient research in these regions. The incessant wars in these areas, particularly the devastations of the Mongols, in the 13th Century, may have forever destroyed many of the connecting links between the tombs of Central Asia and the graves of the Nile Valley. Our present records of the later part of this history are taken largely from Egypt where silk was a recent Asiatic intrusion and from the wrappings of reliquaries happily preserved in European cathedrals.

The most ancient silks in Egypt were discovered in the graves of Antinöe, a city founded by the Emperor Hadrian in the year 122 A. D. These consist of narrow bands intended to be sewn as ornaments upon linen garments. The dates of these fabrics are around the 3rd and 4th centuries of our era. Curiously enough, they follow patterns found on Greek pottery representing

woolen designs dating from the 5th Century B. C. Later, Persian and Christian motives appear and with the Arabic conquests of the 6th and 7th centuries a new kind of loom and a higher technical knowledge and a wider use of silk appears.

In the 6th and 7th centuries, the busy commercial looms of Alexandria supplied the Mediterranean world with fabrics of fashion. Later, as I have already said, this art and industry were transferred to Constantinople and from there to Sicily and Italy and to northern Europe.

One concluding incident in the long history of silk may be worth recording. The industry built up in Spitafields, near London, by the Huguenots in the late 17th Century needed raw materials. It was, and indeed still is, a prime principle of colonial administration that colonies should supply mother countries with raw materials and take finished products from home industries in exchange. Upon this principle, the British Government in the 18th Century gave great and constant encouragement to the growing of silk and the reeling of cocoons in the then loyal colonies of the Carolinas and Georgia. These efforts were constant and repeated and, in spite of many difficulties, towards the middle of this century (18th), these colonies shipped to England annually about 10,000 pounds of reeled silk and cocoons. The inaugural dress of Martha Washington was made from silk grown, thrown, woven and painted in Virginia. There was a revival of this industry in New England, New York and Pennsylvania in the first quarter of the 19th Century and no little speculation in mulberry trees.

But of all the great textile raw materials, silk has re-

mained most constant to its early home. In the 5th Century, Japan borrowed it from China and her highly accurate mechanical methods in recent years gave her silks preference in silk-producing countries, particularly England and the United States, where automatic machinery requires precisely measured raw materials. China, Indo-China, Siam and India still produce silk; and there are remnants of older industries in Persia and Asia Minor and some small production still comes from Italy. But silk demands a population skilled in horticulture, of no mean mechanical ingenuity, and willing to work for from ten to twenty cents a day. So it has stayed largely at home, while cotton, flax and wool have wandered all over the surface of the earth. Their present centers of production have little relationship to their sources of origin or to the mechanical methods of conversion.

No phase of the cotton or indeed the textile industry is of greater importance than the art of printing fabrics by various methods. . . . The modern contribution to this ancient art is the machine invented by Thomas Bell in Scotland, in 1775, which prints a continuous pattern by means of engraved copper rollers. Back of this invention lies a thousand years and more of development, most of which belongs in the Orient. The first record that we have of printing comes from China and is related to the printing on paper with carved wooden blocks.

During the T'ang dynasty, China made the great, if unconscious, contribution of block-printing to the cotton textile arts of India and later of Europe. Professor Carter refers to this matter as follows:

"During this golden age of Chinese genius (712–756), a great variety of devices was being evolved in the

Buddhist monasteries of China for the reduplication of sacred books and sacred texts, an activity that reached its climax in block printing sometime before the end of the Golden Age.

"This activity in devising methods of reduplication can best be studied from the finds of Tun-Huang and those of Turfan, the two places where the manuscript records of early Buddhism on the borders of China have been preserved. Here are found, not only the rubbings from stone inscriptions, but also stencils and pounces, printed textiles, seals and seal impressions and a great profusion of little stamped figures of Buddha, all of which led the way directly to the art of the block printer."

The earliest textile prints extant are in the Museum of Nara, Japan, and are dated around 734 A. D. The most ancient account of mass production of printed material also comes from Japan. The pious Empress Shotoku, in or about the year 774, ordered that one million Buddhistic charms should be printed from wooden blocks and distributed to various shrines and monasteries in order to counteract an epidemic of small-pox. Some of these charms are still in existence in Japan today. But we do not know how successful the experiment was since Her Imperial Highness died of small-pox before her order was completed.

Among the related methods of applying design to cloth are the famous Japanese stencils, the wax and resist dyeing of Java, and the more varied and more beautiful examples from India, and the block-printing, to which I have referred. All of these arts are immensely ancient and some of the processes are applied to yarn to be woven as well as cloth already woven. The art of block-

printing arrived in Samarkand from China towards the latter part of the 8th Century and was diverted by the Mohammedans into India as a method of textile, rather than of book, printing. The Mohammedans already had their "Book," The Koran, and did not need any Chinese novelty to reproduce books. Block-printing, therefore, was added to the earlier methods of painting, resist and mordant dyeing in India, eventually passed into Egypt, and from Egypt into European monasteries. The introduction of the Huguenot block-printers into England has already been commented upon and this was followed towards the latter part of the 18th Century by Thomas Bell's cylinder machine.

The printing machine, like other textile machines, has been enormously developed during the past century and a half, but is basically the same in principle, since it still depends on engraved copper rollers to transfer design and color to cloth. Today, the world's production of printed cottons, silks, synthetic fibers and wool, runs into countless billions of yards. But it is needless to add that the standards of art and color, design and interest rest with the earlier hand processes rather than with the machines of today. We must still seek our artistic standards in the past, not in the present, nor, under existing conditions, does the future look more promising.

The history of Old World textiles is a part of the confused history of three continents, Asia, Africa and Europe. Nowhere is there told, in all this vast area, a complete textile story. The tendrils of each patient investigation and each new discovery, in history or archaeology, reach out again to other peoples and into widely scattered geographical and time areas. We are dealing with separate inventions and discoveries and

regional arts in terms of racial movements, national cultures, wars, trade, invasions and the migrations of peoples. These records are contained in ancient graves, in the dust of ruined and forgotten cities, and in many ancient languages, some of which are almost undecipherable to modern scholars. And in the end it must be admitted that there are many gaps in the record and that data are incomplete, and that conclusions may only tentatively be drawn. This history involves the records of many vague peoples of antiquity and their modern descendants, and at least 6,000 years of recorded civilization.

In all the world there is only one region where we may study a complete textile history, the creative efforts of a single racial group, living within a known and contiguous geographical area, over an immense period of time. In Peru, west of the Andean rampart, from innumerable graves, along the Pacific coast, one of the world's greatest, and certainly the world's most complete textile art has been preserved to mankind. Peru had no contact with other peoples of a different race and no written language to confuse modern scholars. Her record consists of documents miraculously preserved by the most perfect desert conditions in all the world.

The enormous quantities of fabrics taken from these graves during the last 50 years (and still being discovered) contain every basic technical method of fabric construction, every type of fabric decoration known anywhere else in the world, and also a large number of technical methods not as yet found outside of these fruitful graves.

There is no explanation for the appearance of human genius, nor any formula by which the evolution of gen-

ius, in its material forms of expression, may be predicted. The technical basis of the Peruvian complex is the cotton loom and the cotton plant and methods of cotton spinning which are widely scattered throughout the Americas as far north as the deserts of the southwest. And in many of these regions there are high achievements in other arts—in pottery, in architecture and in stone-carving. But only in Peru do we find this surpassing and amazing excellence in the textile arts. The single factor in Peru which is different from all other textile areas in the New World is the presence of the camelidae, the llama, vicuna and alpaca. These fibers are the only large quantity of animal fibers in America which are susceptible to the finer methods of dyeing and which take color in the same manner as the wools of Central Asia and the silks of China. Like these Old World fibers, they excited the textile imagination of a gifted people. The presence of these fibers in Peru offered to the genius of Peru a chromatic opportunity denied the other weaving centers of the New World.

The great modern textile industries have covered the world with cotton plantations and sheep pastures, and have increased the production of silk and flax, but they have not created a single new natural fiber of importance. Without these ancient fibers, the modern textile industries could not exist. The modern synthetic fibers developed through chemical research from cellulose are only now beginning to make a slight impression on the industry or on the consumer. Recently, a new fiber has been added, chemically developed from milk; and another fiber, evolved from man's oldest synthetic product, glass, has made its appearance. Less than 100 years ago, modern chemical research began the creation and pro-

duction of synthetic dyes from coal tar, but the great history of color lies with the ancient dyes. Modern engineers have evolved the machines of the 18th Century into miracles of speed and precision and vast production. All this is admitted. And admittedly all these matters were great cultural achievements and the short time allowed for their development almost miraculous.

All these new creations are still in the status of experimentation—in a period of development. The basic principles of spinning and of weaving, the fundamental types of cloth, the divine conception of color, design, texture and pattern, belong in the ancient, and not in the modern history of cloth. The modern industry must still rely upon ancient crafts for both technical and artistic guidance. The Past has taught us all we know of the fundamental and basic factors in textiles. But the Past has by no means taught us all that the Past might teach us. It is estimated that in the world today there are gainfully employed over fourteen million individuals in the production of various forms of textiles. England, the United States, Japan and Czecho-Slovakia represent the larger producers of machine-made yarns and cloths. But few modern nations are lacking in well-organized, socially and politically encouraged and tariff-protected industrial textile units. At the same time, no inconsiderable portion of this great body of textile workers is still employed on tools and implements which are too ancient for other than comparative culture dates.

India, China, the islands of the Indian Ocean, certain favored areas of Central America, Mexico and Peru, still produce textile products by craft rather than industrial methods. In this same group we must include that tragic remnant of craft workers devoted to the pro-

duction of hand-knotted carpets in the Near East and Greece, now suffering from disorganization and from vicious and corrosive forms of commercialism.

An examination of existing textile processes and methods indicates that no method, however ancient, no invention, however venerable, for the production of cloth, but is still in existence somewhere in the world and still has an important social and economic status. In advancing into technical, mechanical and industrial areas of production, the world has by no means abandoned those inventions upon which modern mechanization depends for its models and standards.

First among all modern European nations, France has retained the earlier arts of cloth-making; has deliberately refused to relinquish craft methods and craft philosophies in favor of the power machine. Her textile industries are linked rather to the Middle Ages and the Renaissance than to the modern age of mechanical mass production. She has elected to be the modern world's laboratory for beauty, style, texture, design and, to a large degree, for new technical improvisions in cloth. She expresses the ancient traditions and arts in their modern forms and has retained the standards of quality rather than attempted to compete in quantity and in low cost production with the rest of the mechanized world.

The modern mechanized industries give the appearance of great security. But, as a matter of fact, they are highly transient and can disappear without leaving a trace. If any of the great industrial nations, such as Japan, England, Czecho-Slovakia or the United States were to cease producing textiles by mechanical methods, the gap would immediately be filled by an increase of production in the remaining countries. Within the last

generation over twenty million cotton spindles went out of operation in the eastern part of the United States and almost immediately reappeared in the southern states. Within the last 10 years England has lost several billion yards of world's trade in cheap cotton cloths to the looms of Japan and India. But if France were to cease producing French fabrics, this loss could not be replaced. The industries of France are built upon traditional skill and upon a tradition in art for which there is no substitute. Anything that might happen to these industries in France would be of the utmost concern, not only to France, but to the entire world.

Since the World War, the Scandinavian countries have rapidly developed their old craft industries and may, with France (although to a lesser degree), be now regarded as a modern source of inspiration for the textile arts based upon the craft methods and artistic traditions of the past. Even in these sturdy northern nations, their newest textile achievements are reminiscent of their earlier contacts both by land and ocean routes with the Orient. The most technically advanced of all industries still depends upon the ancient methods and the ancient spirit of production.

CHAPTER XVIII

TOBACCO—THE WEED OF DESTINY

BEFORE the first voyage of Columbus, no one in Europe, Asia or Africa had ever heard of the American narcotic weed, tobacco. But, while a general impression still prevailed in Europe that Columbus had found, not new continents, but a part of the realm of the Great Khan, long before Shakespeare's plays were written, long before the defeat of the Spanish Armada, more than a century before the Dutch founded a fur trading post at the southern tip of Manhattan Island, destined to become the great city of New York, tobacco, as a medicine, and the smoking of tobacco as a social habit was making its way through the world currents of ocean trade into the worldwide affections of men. This same remarkable 16th Century introduced into Europe by ocean trade four new narcotics—coffee, tea, cocoa and tobacco. But by all standards of comparisons, tobacco has the most remarkable history.

The first mention of tobacco in any European language was, of course, in Spanish. It occurs in the narrative of Columbus written by Navarette and, as of the date, November 6, 1492, just twenty-five days after some hardy mariner had cried the Spanish equivalent for "Land, Ho!" from the crow's nest of the *Pinta*. This historic note runs as follows: "Last night came two men (whom he had sent to observe the interior of the island) and they told him how they had walked twelve leagues to a village of fifty

houses; on the road, the two Christians encountered many people proceeding to their villages. Men and women holding in their hands fire brands and herbs which they were accustomed to take in their incense burners."

The good Bishop LasCasas, viewing this same incident in retrospect, had this to say rather in amazement than censure: "These two Christians met on the road many people who were proceeding to their villages; women and men, always the men with a firebrand in their hands and certain herbs to take in their incense burners which are dry herbs wrapped in a certain leaf, also dry, after a manner of a musket made of paper which the boys (Spanish boys) make at the Feast of Pascua del Espiritu Santo: and having lighted one end of it, at the other they suck or inhale, or receive within the breath, that smoke with which the body is soothed, and which almost intoxicates so they do not feel fatigue. These muskets, or whatever we shall call them, they call 'Tobacco!'

"I knew Spaniards on this Island of Hispaniola who were accustomed to taking them, and being reproached for so doing (because it is a vice), replied that they could not stop the habit. I know not what savor or benefit they found in them. Here may be seen the origin of our cigars. Who would have ventured to say, at that time, that their consumption and use would one day become so common and general, and that upon this new and strange vice, there would be established one of the fattest revenues of the state."

The antiquity of tobacco in the Americas rests upon a firmer basis than even Spanish tradition. Pipes have been found in culture levels of the Basket Makers far beneath the relic strata of the most ancient Cliff Dwellers of the

southwest of the United States. This means that tobacco was even more ancient than cotton in this region, and that a date at least as early as the Christian Era may be set for its extensive use. Beautiful stone ceremonial pipes, carved in bird and animal conventions, have been found in famous mounds of the Mississippi Valley and also more modest pipes for indulgence in the social habit.

In Clark Wissler's map of the spread of the uses of tobacco and coca leaf (cocaine)-chewing, he indicates a much wider distribution for tobacco than even of maize or Indian corn. The use of tobacco covers all of South America except the extreme southern tip. In North America, tobacco cultivation and smoking reached the southern tip of Hudson Bay, and the habit of chewing spread along the coast of Alaska almost to Bering Strait.

Almost everywhere tobacco was smoked either in the elbow or the tubular pipe, or in the form of cigarettes or cigars. But in Peru, Bolivia, the Isthmus of Panama, and adjacent jungle areas, the mild narcotic tobacco came in contact with the more powerful coca leaf and the habit of tobacco-chewing was adopted from the coca leaf-chewing habit, using a tiny morsel of lime to make saliva flow freely. In the upper regions of the *Amazon,* and along the northern coast of South America, tobacco was used as snuff. This habit was borrowed from the powerful narcotic *cohoba,* made from *pipta-derma perigrina.*

Along the western coast of North America, the habit of tobacco-chewing is mixed up with the smoking of the tubular pipe, suggesting that tobacco penetrated these regions from Mexico for the tubular pipe and from the south or Andean area for chewing.

The entire eastern seaboard of North America and

westward across the *Mississippi,* and along the southern coast of Brazil, was the ancient area of the elbow pipe, the prototype of the pipe smoked by the people of the United States, England, and Holland with such conscious virtue, until the World War changed the balance in favor of the milder cigarette.

In Central America, Mexico and in the Far West of North America, the tubular pipe and the cigarette (tobacco rolled in corn shuck) were the preferred methods of smoking. The tubular pipe of clay or hollow reed is obviously a modification of the cigarette. The Indians of the West Indies and parts of the basins of the *Amazon* and *Orinoco* smoked cigars. In some instances these cigars were so enormous that a special U-shaped holder was employed with a sharp point to drive into the ground. From the appearance of these cigars, it was wiser, perhaps, to take them lying down.

I have dwelt at some length on the native methods of smoking since these in turn powerfully influence, down to today, the European habits connected with tobacco. The early English smoked pipes because they had contracted this form of the smoking habit from elbow pipe-smoking Indians with whom they came in contact. The Portuguese and the Spaniards smoked cigars and cigarettes because it was in these forms that they first became acquainted with tobacco. The French followed the cigarette custom, more or less, since they took their habits from the Portuguese from whom they first obtained tobacco.

Even today the pipe finds little favor in either Mexico or Portugal or Spain, or indeed, throughout Latin America. These nations still prefer the original native method, that is, the cigarette.

Tobacco-smoking has never replaced coca leaf-chewing in Peru and Bolivia.

Before the introduction of tobacco into China, opium was never smoked. It is believed by Laufer that the famous opium pipe was copied from the tobacco pipe introduced from the Philippines in the first decade of the 17th Century. It has also been stated that the Dutch introduced a combination of opium and tobacco-smoking into Java to pacify or stupefy the war-like natives.

Tobacco was at first highly esteemed by the learned physicians of Europe as a general cure-all. Benzoine, a 17th Century physician, says: "These leaves were strung together, hung in the shade and dried, and used whole or powdered, and were considered good for headaches, lock-jaw, tooth-ache, coughs, asthma, stomach-ache, obstructive kidney trouble, diseases of the heart, rheumatism, the poisoning from arrows, carbuncles, polypus and consumption." They did not know what it did to the inside of patients, but this was unimportant. If doctors dwelt on such trivial details, the pharmaceutical science would be in a bad way. Tobacco was new, it created considerable disturbance; it smelled and tasted vilely; it smoked handsomely; it was exotic, hard to come by and expensive. What more could be asked for any new medicine?

That terror of the Spanish Main, the pious old sea dog and practical slave hunter, Sir John Hawkins, in the year 1565, visited the coast of Florida and came upon the Huguenot settlement on the coast of Florida. "The Floridians," says this worthy, "have a kind of herb dryed, which, with a cane and an earthen cup in the end, with fire and dryed herb put together, do sucke through the cane the smoke thereof, which smoke satisfieth their hunger and then they live for four or five days without meat

or drink. And all this the Frenchmen used for the same purpose: yet do they holde opinion withal that it causeth water and fleam to void from their stomach."

The late Dr. Berthold Laufer took a more than scholarly delight in the exposure of romantic myths passing as historic incidents. For this alone he deserves our gratitude. He gives line and verse to prove that Sir Walter Raleigh was not the first to introduce tobacco into England. King James the First (who ordered his execution because of an unsuccessful speculation in unimproved Spanish American real estate), accused Sir Walter, among other things, of introducing the "filthy weed." But his Majesty was as wrong about tobacco as about the Divine Right of Kings. Poor Sir Walter knew only the North American plant, *tabacum rustica,* not the gracious *tabacum nicotina,* the gift of the West Indies or South America to the world.

William Harrison, who completed his *English Chronology* in 1593, but referring, in the following quotation, to events in the year 1573, says: "In these days the taking-in of the Indian herbe called Tobacco by an instrument formed like a little ladell, whereby it passeth from the mouth into the head and stomach is grettle taken to and used in England against rhumes and some other diseases ingendered in the longes and inward parts and not without effect. This herbe is not as yet so common, but for want thereof divers do practize for the like purposes with *nicetean hyosciamu* or yellow herbane, abeit not without gret error; for although that herbe be a soverne healer of old ulsers and sores reputed incurable outwardly, yet is not the smoke or vapour so profitable to be received inwardly."

The plant which Harrison describes is, unquestionably.

the *tabacum nicotina,* which, at this time (1573), had been imported into England as a medicinal herb from Portugal. This same plant did not reach Virginia from the Island of Trinidad and replace *tabacum rustica* until 1610. In other words, the leaf for which Virginia became so famous was grown in England and France thirty-seven years before it was known in Virginia. It is named *tabacum nicotina* because Jean Nicot, the French Ambassador to Portugal, imported the seeds into France.

Laufer was of the opinion that Francis Drake, or some of his sailors, may first have introduced social smoking into England, having learned the custom in the Islands of the Spanish Main. But smoking was certainly introduced or re-introduced into England by Ralph Lanes, returning colonist from Virginia, who arrived in England July 27th, 1586. Of course, there may have been many such unnoted introductions, since there were many more or less piratical expeditions into the Spanish Main at this time.

William Camden, historiographer of Queen Elizabeth, writing in 1615, says: "And these men (Lanes' colonists who did not colonize) who were first brought back were the first that I know of that brought into England that Indian plant which they call tobacco or nicotine which they used against crudities being taught it by the Indians. Certainly, from that time forward, it began to grow into great re-quest and to be sold at a high rate, whilst in a short time, many men, everywhere, some for wantonness, some for health sake, with insatiable desire and greediness, sucked in the stinking smoak thereof through an earthen pipe, which, presently, they blew out again at their nostrils: insomuch as tobacco shops are now as ordinary in most towns as tap-houses or taverns, so that Eng-

lishmen's bodies (as one said wittily) which are so delighted with this plant seem, as it were, to be degenerated into the nature of barbarians since they are delighted and think they may be cured with the same things which the barbarians use."

King James the First, called by Henry of Navarre "the wisest fool in Christendom," had a word to say about tobacco: "Now to the corrupted baseness of the first use of this Tobacco, doeth very well agree the foolish and groundlesse first entry thereof into this Kingdome. It is not so long since the first entry of this abuse amongst us here, as this present age cannot very well remember, both the first author, and the forme of the first introduction amongst us. It was neither brought in by King, great Conqueror nor learned Doctor of Phisike. With the report of a great discovery for a conquest, some two or three savage men, were brought in, together with this savage custom. But the pitie is, the poore, barbarous men died, but that vile barbarous custom is yet alive, yea, in fresh vigor: so it seemes a miracle to me, how a custom springing from so vile a ground, and brought in by a father so generally hated (with regal delicacy he thus refers to Sir Walter Raleigh) should be welcome upon so slender a warrant."

On the morning of October 29th, in the year 1618, according to the Dean of Westminster, before Sir Walter mounted the scaffold, "he eat his breakfast heartily and took tobacco," and for this the gallant gentleman received posthumous censure, but was defended by Audrey who wrote: "He took a pipe of tobacco a little before he went to the scaffold, which some female (or perhaps formal persons) were scandalized at: but I think 'twas well and properly done to settle his spirits."

King James may have objected to tobacco, but he had not objected to taxes raised on the weed. Queen Elizabeth (who endeared herself to her subjects by her perfect horror of all taxes) only taxed tobacco two pence per pound. King James raised this modest excise to six shillings and ten pence per pound, an increase of some 4,000%. He next prohibited importation from Spain and Portugal and charged fifteen pounds for a license and fifteen pounds more each year to renew it. All of which caused great rejoicing among the smugglers.

King James returned to his tobacco literature with this final blast: "A custom lothsome to the eye, hateful to the nose, harmful to the brain, dangerous to lungs and in the black stinking fumes thereof neerest resembling the horrible Stigian smoke of the pit that is bottomless."

In 1660, there is a more cheerful note: "Tobacco, itself, is by few taken as medicinal; it is grown a good fellow and fallen from a Physician to a Complement. He's no good fellow that's without burnt Pipe Tobacco and His Tindes Box."

The plague, in 1665, led to the more extensive use of snuff as a medicine or preventive. But the great spread of the use of snuff in England was a matter of fashion rather than medicine. In the reign of Queen Anne, French manners had come into vogue and snuff, and the ornate and sometimes beautiful snuff boxes, now treasured by collectors, came into fashion. Tobacco smoking became taboo in good society and started that long social descent to Stanley Baldwin's pipe, that notable symbol of sturdy English democracy and the return of the English Corn Laws in their 20th Century version.

Thomas Jefferson had a word about tobacco. Writing of a conference with Count de Vergennes in 1785, he says:

"I observed to the Count Vergennes that France paid to us two million of livres for tobacco, that for such portions as were bought in London, they sent the money directly there, and for what they bought in the United States, the money was still remitted to London by bills of exchange, whereas, if they would permit our merchants to sell this article freely, they would bring it here and take the returns on the spot in merchandise, not money. The Count observed that my proposition contained what was doubtless useful, but that the King at present received on this article 28,000,000 livres annually, which was so considerable as to render them fearful of tampering with it: that the collection of this revenue by way of Farm was of very ancient date and that it was always hazardous to alter arrangements of long standing and of such infinite combinations with the fiscal system."

The connection between tobacco and taxes is once again made evident.

Laufer states that the first mention of tobacco in Asia is contained in the diary of Captain Richard Cocks, English factor of Hirado in Japan between the years 1613–1621. An entry of August 7th, 1615, is as follows: "Gonosco Dono came to the English House, and, amongst other talk, told me that the King (that is, the Dairnyo of Hirado) had sent him word to burn all tobacco, and to suffer none to be drunk in his Government, it being the Emperor's pleasure it should be so; and that he, for to begin had burned four piculls of hundred weight that day, and had given orders to all others to do the like, and to pluck all which had been planted. It is strange to see how these Japanese men, women and children are besotted in drinking that herb, and not ten years since it was in use first."

In the log book of William Adams, an English sailor wrecked on the island, who became a lesser noble of Japan, appears an entry (about 1615) as follows: "Four tabaka pipes purchased at Kyoto."

Tobacco was introduced into Japan by the Portuguese in the year 1605 and eagerly planted around Nagasaki and spread rapidly in spite of all prohibitory laws to the contrary. It was also esteemed as a medicinal plant. The Japanese word "Tabako" is clearly derived from the Portuguese "tobacco."

China received her tobacco from the Philippines where it had been introduced by the Spaniards. It became known in the Province of Tu-Kien about 1620, and Chang-Kiai-pin, a noted physician, writes as follows: "When our forces entered this malaria infested region (Yim-Nan) almost everyone was infected by this disease, with the exception of one battalion. To the question, 'Why they had kept well?' these men replied that they all indulged in tobacco. For this reason, it was diffused into all parts of the country. Everyone in the southwest, old and young without exception, is at present addicted to smoking by day and night."

In the year 1683, an Imperial Chinese decree threatened with decapitation all who should sell tobacco. An earlier decree refers to smoking tobacco as a more serious offense against society than the neglect of archery practice, and the Emperor sorrowfully exhorts as follows: "It has become impossible to maintain the prohibition of tobacco smoking because you princes and others smoke privately, though not publicly; but the use of the Bow must not be neglected."

Asad Bey, wiley merchant of Kazwin, described a vain attempt to corrupt the great Emperor Akba in the year

1605 and also a shrewd stroke of trade. "As I had brought a large supply of tobacco and pipes, I sent some to several of the nobles, while others sent to ask for more; indeed all without exception wanted some and the practice was introduced."

When, however, he offered the King a pipe, after a few royal puffs, this Majesty's physician stepped forward and forbade further indulgence. In vain did Asad quote the opinions of European doctors of physic as to the merits of tobacco. The physician said in reply: "We do not want to follow the Europeans and adopt a custom which is not sanctioned by our wise men without trial." Even Asad admitted he was a good physician and I have come to esteem him very highly.

The Emperor Jahangir, in the year 1617, issued a prohibition against tobacco in royal decree.

"As the smoking of tobacco has taken very bad effect upon the health and minds of many persons, I ordered that no one should practice the habit. My brother, Shah Abbas (King of Persia), also being aware of its evil effects had issued a command against the use of it in Iran. But Khain-i-Atan was so much addicted to smoking that he could not abstain from it, but often smoked."

Just when Africa first received tobacco, or by whom it was first introduced, is not known. Africa is a large place and slave dealers did not keep accurate statistics. In the more ancient records there is no mention of any such plant. It was wholly unknown until after the beginning of the Afro-American slave trade.

Tobacco belongs in the list of eighty plants introduced from America into Africa during the 16th and 17th centuries. This list includes, among others, maize, manioc, the sweet potato, several types of peanuts and cactus (for

cultivating the cochineal insect) as well as the famous narcotic weed.

It is needless to write that tobacco was eagerly accepted by the negroes of Africa. The Portuguese and Dutch used tobacco in trade and the Colonists in South Africa exchanged a string of tobacco, as long as a bullock, for a bullock, to the great satisfaction of the native herders and to the delight of the sturdy Dutch burghers of Cape Town who had more tobacco than cattle.

The Chinese merchants introduced tobacco smoking to the natives of Siberia; and the Russian traders, in the early 19th Century, carried the habit to Alaska where the skilled Eskimo carvers in stone and ivory made beautiful pipes which are properly regarded as works of art.

Thus, in a little more than three hundred years, tobacco, as a plant, a commodity, a narcotic habit, and a word, circled the entire globe and had returned to the hemisphere which had given it to the world. Neither the wrath, nor the petulance of kings, emperors and shoguns, neither the difficulties of travel, nor the burden of taxes, nor the advice of physicians were able to stay, or even seriously retard, its progress. What a commentary upon the weight of whim as opposed to want in the commerce of men!

Tobacco played a modest part in the events leading up to the American Revolution and first brought into the public's eye that fiery patriot, Patrick Henry. Warehouse receipts for tobacco were legal tender in Virginia and, by virtue of an old statute, each clergyman of the established church was entitled to receipts for 16,000 pounds as an annual stipend, at a value of two pence per pound. From 1755 to 1758, due to financial distress caused by the

French wars, a law was passed by the Assembly which permitted these salaries to be paid either in kind or in money at the old rate of two pence per pound. By 1759 the actual market value of tobacco had risen to six pence per pound and the clergy grew restless. A 200% increase in salary is never hard to take, nor easy to forego. The matter, as might be expected, was called to the attention of the Bishop of London; he, in turn, called it to the King's attention, who promptly vetoed the law. Whereupon a jury of Virginia tobacco planters was called upon to assess damages in the trial case of Rev. James Maury. Patrick Henry, rightly regarding himself as among friends, remarked that "a King who, from being the father of his people degenerated into a tyrant, forfeits all right to obedience." The Jury, pondering the matter deeply, and well knowing who must pay the tax, awarded a verdict of one penny damages to the outraged cleric; whereupon the clergy tried to have Patrick Henry indicted for high treason. But the electorate of Louisa County, Virginia, in 1765, responded by electing this able and fearless attorney to the Colonial Assembly and in this manner suited the penalty to the crime.

Sir Josiah Child, merchant and philosopher, of the 17th Century, and an admirer (with reservations) of the Yankees, gave due consideration to New England's contraband trade in tobacco and other commodities. "The people of New England, by virtue of their primitive charters, being not so strictly tied to the observation of the laws of the Kingdom, do sometimes assume a liberty of trading contrary to the Act of Navigation, by reason whereof many of our American commodities, especially TOBACCO and sugar, are transported in New English shipping directly into Spain and other foreign countries with-

out being landed in England or paying any duty to His Majesty, which is not only loss to the King and a detriment to the navigation of old England, but also a total exclusion of the old English merchant from the vent of those commodities in those ports where the New English vessels trade, because, there being no custom paid on those commodities in New England, and a great custom paid upon them in old England, it must necessarily follow that the New English merchant will be able to afford his commodity much cheaper at the market than the old English merchant: and those that can sell cheaper will infallibly engross the whole trade sooner or later."

A few statistics of the growth of the tobacco trade from Virginia alone may be of interest. It must be borne in mind that even at the early dates at which these statistics start, tobacco was already grown in many parts of the world besides the Americas, North or South. These figures refer only to Virginia and are taken from a report of the United States Department of Agriculture.

In 1618, 20,000 pounds of tobacco were shipped to England. (No allowance is made for leaf shipped by the Dutch or Yankee smugglers.) By 1639, 1,000,000 pounds were exported. Between 1664 and 1774, or during one century, the amount exported rose from 20,000,000 pounds to 107,000,000 pounds per annum. Since 1870, the export has never fallen below 200,000,000 pounds, and, since 1899, never below 300,000,000 pounds.

Today the world's crop is estimated at between 4,000,000,000 and 5,000,000,000 pounds, of which the United States supplies a little less than one-third. India and China now compete with the United States in bulk production, but by no means in quality.

In the first years of this century, cigarettes, while

known, were not regarded with favor. Substantial men smoked cigars; lesser men, mechanics and college boys, smoked pipes; tobacco-chewing and snuff-taking were common enough. But for a man to smoke a cigarette publicly was almost beyond the pale of good society, and quite beyond it for a woman.

Times and customs have a habit of changing. In the year 1936, according to *Barrow's Weekly,* 151,000,000,000 cigarettes were smoked in the United States.

The volume of consumption of cigarettes in the United States has increased fifteen times during the last quarter of a century. Between 1910 and 1920 the population of the United States increased 14.9%, while the consumption of cigarettes increased 49%. Between 1920 and 1930 the population increased 16.1% and the consumption of cigarettes 100%.

In the year 1910, twenty times as much tobacco was used in the United States in cigars and by pipe smokers, chewers and snuff dippers as by cigarette smokers. In 1936 the poundage of tobacco used by cigarette smokers almost equalled the poundage consumed in all other forms of tobacco.

In the year 1915, the first full year of the World War, and two years before the troops of the United States were in France, 138,097,000 pounds of tobacco was consumed in cigars and only 56,551,000 pounds in cigarettes in the United States. Pipe smokers, chewers, users of snuff, accounted for 370,794,000 pounds of this old Indian weed, or, a total of 565,442,000 pounds for all uses.

In 1930, 137,901,000 pounds of tobacco was consumed by cigar smokers. But cigarettes had gone ahead with great strides to a consumption of 374,849,000 pounds,

while the consumption of tobacco by pipe smokers, chewers, snuff-takers, had fallen off to 293,990,000 pounds.

It is a little more convenient to consider the matter from the point of Government excise taxes. Ever since the Spanish Government and King James I set the example, tobacco has been heavily taxed by all nations. In 1915, the taxes in the United States on cigars amounted to $21,903,000, and, on cigarettes to $20,983,000. Smoking and chewing tobacco paid a combined tax of $32,198,000 or almost $10,000,000 more than either cigars or cigarettes; snuff paid only a modest $2,384,000 in taxes.

Between 1917 and 1918, when the American soldiers were still in France, the revenue from cigarettes almost doubled. From there on the climb was almost vertical, slowing down in tempo slightly during the depression, (1929), but, as I have shown, starting up again since 1931 with vigor renewed.

In 1930, the revenue from cigars had fallen to $18,296,000. But the tax on cigarettes had risen to $358,915,000 per year! Smoking and chewing tobaccos were second with $58,377,000 and that stealthy, anti-sneeze snuff had risen from $2,387,000 in 1915 to $7,190,000 in 1930. Between 1915 and 1931, the United States Government collected a total tobacco revenue of $5,151,818,000, and of this stupendous total, cigarettes furnished $3,147,200,000, or more than three-fifths. This does not include State and Federal income taxes nor does it include taxes on income derived from tobacco securities. Moreover, it refers only to the United States.

The matter becomes all the more remarkable when we consider the fact that all the tobacco plants now growing in the world could be planted in an area about one-fourth

the size of the State of Virginia, assuming that every acre was planted.

This increased use of cigarettes is due to many reasons sufficiently obvious. First and foremost is the fact that the mechanical production of cigarettes in the United States has been carried to an almost incredible degree of perfection; and, in spite of taxes, cigarettes are cheap and of excellent quality. In the United States, the automobile has played its part. You cannot light a pipe with any air of charm or satisfaction when going at a speed of fifty miles per hour. This folly can only be committed with a cigarette. Many automobiles have special electric lighters for cigarettes. The fact that women are now smokers is, of course, one of the main causes for the increase. But there remains the explanation of why women, as well as men, should have so suddenly changed their attitude toward tobacco in favor of cigarettes. Why have not other forms of tobacco using increased to the same degree? Why should cigarette smoking and snuff-taking have so vastly increased during the period which saw a decline in pipe and cigar smoking and chewing?

People do not abruptly change their deeply rooted narcotic habits nor acquire new ones without due cause. This cause is usually some stirring, emotional experience of sufficient force and duration to alter old habits and encourage new ones. Such an experience was, of course, the World War.

During the war, English boys and girls, and boys and girls from the United States, Canada, Australia and New Zealand came into romantic and highly emotional relationship with the gallant youths of France. The French were cigarette smokers. Moreover, millions of American and English boys had just come into the smoking age and

naturally adopted the most prevalent form of the habit in their environment. Accordingly they took up cigarettes and partly abandoned pipes. The girls, seeing a world gone mad with slaughter and realizing that the casualty lists posted each day were not only soldiers, mere pawns in the game of war, but their future mates, took action. Another generation or so might, of course, adjust the sex balance in population. But girls were interested in the particular generation then dying in the trenches. So they kicked into the social ashcan a lot of foolish restrictions piled on them by the very generation which had dumped the war on them; they bobbed their hair, wore short skirts, took up sports, economic philosophy and cigarettes; and they also took charge of their own lives. They are still, thank God, in open rebellion.

The English-speaking nations had learned their smoking habits from the Indians who smoked elbow pipes. The French, in the 16th Century, learned smoking from the Portuguese who had acquired the habit from "cigarette" Indians. Hence the rapid change in smoking habits since 1915 in a sense goes back to habits contracted from the New World in the late 15th and early 16th centuries.

The change in snuff-taking habits was caused by industrial changes. During the last fifteen or twenty years, industrial processes have been vastly speeded up and have grown more intricate. Smoking is forbidden in most factories and mills, and chewing, for obvious reasons is not regarded with favor. Hence the taking of snuff has been substituted. Society may, from time to time, change the fashion of taking tobacco, but for more than 400 years no Government in the world has been able to suppress the growth, sale or use of tobacco in some form.

From a few ounces of seed, a few earthen pipes, a few bags of dried leaves, it has become one of the world's major crops, the largest taxpayer and the most universal habit.

CHAPTER XIX

IRON

THE first iron men knew was cast from the sky as the missiles used by the gods in their private wars and to admonish erring mankind from time to time. Fortunately for the peace of mind of antiquarians, the iron of meteorites is mixed with from five to ten percent of nickel. Nowhere in the world does pure iron exist, except in Ovifah, Greenland, and this was beyond the reach and the imagination of the primitive Asian smelters as they searched for some substitute metal when copper and tin to make bronze began to grow scarce. All iron, regardless of its form, which contains any appreciable content of nickel is of meteoric origin. All specimens free of nickel were smelted by man.

A note on early iron smelting in Egypt in the June, 1937 issue of *Antiquity* throws a new light on the magical iron of predynastic times. Professor Quiring writes:

"The *Nile* sands, and in particular the gold-bearing gravels and sands of Nubia, contain grains of magnetite of high specific gravity, and of iron content up to 65%. Investigation conducted by Professor Dr. V. Z. Muhlers in Abyssinia and South Nubia between 1929 and 1931 show that about half of the residue obtained from gold washings consists of magnetite grains. . . . As a consequence of the introduction of gold smelting into Egypt towards the end of the pre-dynastic period, the smelters were able to use the finely divided sheets of gold as well

as the heavier particles. The Nubian gold washers, therefore, sent their mixture to be separated in Egypt. As a result of smelting, the fine gold and magnetite grains together in crucible, in a reducing atmosphere obtained by the combustion of spreu (chaff of clover and straw) a rich iron slag was formed above the liquid gold together with a layer of pasty iron. The latter were immediately ready for forging.

"This investigation appears to satisfactorily account for the peculiar feature of the iron industry in Egypt, viz., its diminutive output and its unprogressive character, the high value attached to the metal by its association with gold in jewelry, and its use for beads, finger rings and other small articles."

Naturally enough, man confused lightning and thunder with meteorites, and held them both in the greatest respect. Compared to this artillery of the sky, his puny spears, slings, dart-throwers and bows were trivial matters. Later, when men perfected cannons and gunpowder, it was recognized that while man's implements lacked something in dramatic character, they could be more readily and more effectively directed towards the greatest business of man, which, curiously enough, is the destruction of man. Since the World War, our interest in falling stars has been more or less romantic; we have come to recognize their inefficiency. Of later days, doctors of physics have taken to making their own lightning, and man, becoming himself a sort of demi-god, has lost no little of his respect for the various Joves who, from time to time, have troubled the mind of man with thunderbolts, which seldom hit. There was, however, a time in our own history when meteors foretold the death or birth of kings, plagues, and victories or defeat in warfare, and in the

last century, learned men believed the stone axes dug up by accident to be the results of lightning striking the earth.

All over the world, primitive people have a great respect for meteors. There are several from Greenland (Alaska) in the Museum of Natural History, in New York, some weighing several tons. They were worshipped by the Eskimos and are not without a certain awesome interest in their present location. In the British Museum there are preserved 289 meteors which fell and were found between 1815 and 1914. Some of them may have foretold the victory at Waterloo, or the beginning of the World War. The famous Kaaba, the black stone at Mecca, was the one "image" Mahomet feared to destroy. It is still a sacred object to millions of the sons of the Prophet. It was once a meteor that someone found while it was still hot.

Iron beads, containing nickel, and, hence of meteoric origin, have been found in Egypt in the tomb of Gersah, dated 3,000 B. C. and in Ur of Chaldea about the same date. But in Tel Asmar, in Mesopotamia, a bronze dagger handle was found to contain iron, the remains of a vanished blade. This iron did not show a trace of nickel and hence is believed to have been smelted from ore by man and not made by the gods. The date of this vital document is 2,800 B. C.

Smelter iron and men are ancient friends. As early as 2,300 B. C. a Cappadocian tablet refers to iron as "barziali," the "Metal of the Gods," and even thousands of years later, when iron smelting had become a familiar industry, before men purified iron with fire, they purified themselves with magic. Man did not propose to take any chances with a metal the gods hurled about the skies.

Western and northern Europe had their own iron myths. The swords of King Arthur, "The arm in white samite clad," the weapons of Sigfried and Lohengrin were of iron and had magical properties. These are only a few of the iron sword myths. Wotan, smith of Gods, had many rivals and more followers.

The Egyptian priests were a most practical lot of philosophers and serious and conscientious undertakers. It was one thing to fill a tomb with food, but how could the dead eat with locked jaws? Clearly, here, if anywhere, was the place for magic. What substance could so potent as "bia," the metal from the sky, the weapon of Seth, the Storm God, whom the Greeks called "Typhon," whence comes the name we still give to a fierce storm? Hence we find in very ancient tombs along the *Nile*, where only copper (not yet bronze) was used for tools and weapons, little adz and chisel forms used at one time in loving delusion to open lips forever sealed by the Dark Angel.

Partington, in his *History of Organic Chemistry,* says a definitive word about iron and many other matters: "The northwest part of the Hittite Kingdom was the cradle of a development in iron technology and is the place where the Jewish and Greek traditions locate the earliest making of that metal." When Jeremiah asks, "Shall iron break the northern iron or the steel?", he refers, perhaps, to the Chalybis, an Asiatic people living in the caves and dens along the coast of the Black Sea.

A small lump of iron has been found in Crete, dated tentatively 2,000 B. C. Whether meteoric or smelted is as yet to be determined. Hammurabi (2,200 B. C.) mentions either a helmet or more probably an iron bowl. Borzillai,

friend of the stout-hearted David, that good slinger, means "Man of Iron." David's choice of a friend was a wise selection.

The Hebrews were mighty warriors, but had great trouble with the chariots of iron used by the men of the plains. In *Judges* 1–19: "And the Lord was with Judah and he drove out the inhabitants of the mountain but could not drive out the inhabitants of the plains because they had chariots of iron." But the Hebrews came in time to understand the virtue of iron as *Chronicles,* 20, proves:

"And he brought out the people that were in it and cut them with saws and with harrow of iron and with axes. Even so dealt David with all the cities of the Chaldaic of Ammon, and David and all his people returned to Jerusalem."

Egypt was quite late in adopting iron; it was very rare until the period of the new Kingdom. In the tomb of the warlike Thetmose (1,501–1,447 B. C.), occurred seven iron objects, six of them embellished with gold, proving that iron was then a rare and a precious metal. In commemoration of his seventeenth campaign, he received from the Keptun (coast of Asia Minor) vessels of bia (iron), loving cups of a sort, perhaps. In the tomb of Tutankhamen (1,350 B. C.), was found a beautifully made iron dagger with an exquisitely embossed sheath of gold—a weapon worthy of so excellent a king. It is now in the Museum in Cairo.

One of the earliest documents preserved concerning the munitions industry, was written by Hattuset, then in Asia Minor, to his radiant and all-conquering Lord Rameses II who had recently experienced a little military

difficulty with a set of rough Semitic barbarians. These warriors had iron chariots and iron weapons and knew how to use them.

The harassed viceroy wrote to his troubled Majesty as follows: "As for pure iron about which you have written, there is no iron in my warehouse at Kizwatus and to make it at this time is inconvenient, but I have written orders that it shall be made. As soon as it is ready, I will send you some. At the moment I send only a dagger." (Dated B. C. 1,225.)

Between 1,300 and 1,200 B. C., iron became reasonably common in southern Palestine. There were thrones, altars, statues of men and bulls and women (a curious trilogy), and also spear and lance ax heads, dagger and knives, for the important matter of war, and even sickles, borers, hooks, an iron pick weighing six pounds, hoes, two plows and a large size adz and many iron nails. By this time, iron had passed through magic into war, industry and agriculture. Two furnaces and a pile of slag and ore have been found in northern Palestine, dating respectively from 1,175 B. C. to 1,100 B. C.

The worthy Assyrian kings used to flay their captured enemies alive or impale them outside the walls of beleaguered cities to encourage the rest in virtue. Tegleth-Pileser III (B. C. 745–727), Sargon II (B. C. 722–705), and good old Sennacherib (704–682 B. C.) used to put iron chains upon their prisoners for the short time these prisoners needed chaining. In the foundation of Khorsabad, a treasure of 150 tons of iron was found, including hoes, axes, hammers, plowshares and a mass of grappling hooks weighing about 50 pounds apiece (to be used on the boats of the *Euphrates*); iron chains and nails, link armor and weapons, have been found in the ruins of

ancient Nineveh. Iron, by this time, had become common and was produced in large quantities, almost mass production.

From 1,500 B. C., Asia Minor and Syria exported objects of iron, daggers, sword blades and also jewelry, made from iron in the form of charms.

In Greek lands, iron finger rings of Late Minoan I from Crete appear in trade *circa.,* 1,500 B. C. Iron swords came into use around 1,200 B. C., but bronze swords did not entirely disappear until somewhat later.

Among the Assyrians there was a law forbidding the Hebrews to work iron forges. They had to have their plows mended by native-born Assyrians and were not encouraged to bear iron weapons. By 1,100 B. C., iron ingots, egg-shaped and pierced at one end with a hole for convenience in carrying, were a recognized form of money and by 1,200 B. C., these ingots began to appear in France and Germany and have been dug up in La Tène for which Europe's second iron age is named.

The earliest iron age in Europe occurred in Italy and is dated 1,000 B. C., but the more famous iron age sites are Hallstatt and La Tène. The Hallstatt Age compares with Dipylon (Athens) and archaic periods in Greece, and La Tène was shortly before the classical period of Greek art. The first age of iron, later called Keltic in Britain, corresponds with La Tène on the Continent.

It is evident that the migrations of people and cultures, which swept Europe at these early dates, came from one general region in the East, and from one general and relatively high culture level, and that iron was the important metal of the latest waves of intrusion.

Iron did not at once supersede bronze. The bronze technique was too firmly established and iron was a rela-

tive costly metal and, for some purposes, not always superior to bronze. The Hallstatt graves contained 3,574 objects of bronze, 1,242 of clay, 593 of iron, 270 of amber, 73 of glass and 64 of gold. The glass and the amber suggest trade with both Egypt and the North Baltic. This period spread over Central Europe and crossed the Pyrenees into Spain and Portugal. The center of the culture, or rather the type site, was situated about a prehistoric salt mine near Hallstatt, in Austrian Salzkammergut. In ancient times, there was a wide trade in salt and a great importation of works of art, principally beautiful embossed and modeled bronze vases.

La Tène's epoch was named from a town situated at the eastern end of Lake Neuchatel. In 1881 the waters of the lake were lowered by various engineering projects and a rich and vigorous culture was disclosed. This epoch has been divided into three periods:

La Tène	I — 500–300 B. C.
" "	II — 300–100 B. C.
" "	III — 100 B. C. to Christian Era

Among the iron tools of this era are sickles and scythes, pruning knives and hooks, scissors (very much like those used today to shear sheep or trim garden walks) and rather grim razors. Here also appear the andiron and the gridiron, tined fish spears and fish hooks and boat hooks. Anvils and hammers of this age differ little from those in use today. Armor and shields and helmets of beautiful embossed bronze occur; houses were rectangular in shape and built of timber and dry masonry. Many of these inventions also occur in the earlier Hallstatt period, but not with such elegance of form nor in such profusion.

In this period, the plow with an iron-covered share was

introduced, and planes, spoke-shaves and blacksmiths' pincers suggest a chariot-making industry. It is believed that the crude glass amulet and magical beads were made at this time in these regions, and also iron keys and locks.

The furnace was of the beehive type, made of rough masonry and covered with earth. It was similar to the bronze furnace but, perhaps, larger. In order to get a better draught, necessary for iron, it was usually placed at the top of the hill. The fuel was charcoal and wood and no artificial draught was employed.

Here, iron rests, until the later centuries of the Middle Ages.

The whole history of iron does not, of course, lie in the movement of this metal from East to West. There is a rich history in middle Asia, and the Chinese knowledge and use of the magnetic iron needle for land surveying, passing through Arabic, Catalonian and Italian experiments, was later to have an immense influence on the commerce and navigation of the world. This subject still awaits the large and definitive treatment of specialists in many fields. One single note from Laufer's *Sino-Iranica* may suggest at least a basis for rational curiosity: "Iron (Pin *t'ie*) is mentioned as a product of Sassanian Persia. . . . The Ko-kin-yao-lun says that pin t'ie is produced by western barbarians (Si Fan) and that its surface exhibits patterns like the winding lines of a couch or like sesame seeds and snow. Swords and other implements made from this metal are polished by gold thread, and then these patterns become visible. The price of this metal exceeds silver."

Alexander of Macedonia brought back Persian steel processes to Damascus where weapons of this metal became famous for keenness of edge and flexibility and the

Moors carried the art to Spain; and Toledo blades became noted alike for elegance and usage. I have in my possession a short bolo-knife from Nepal not far from where the Macedonian found this metal, made, perhaps, by similar processes. The quality of this steel is beyond praise.

The Vikings and their descendants in England and France knew iron and were, according to their needs, expert smiths. The art of metal working had a great antiquity around the Black Sea and it is from this region that the early civilization of Scandinavia takes it rise; and, quite naturally, iron mining and working were vital, if late factors in this culture.

Among the grave finds of the North were swords, spears and arrow heads, scissors, helmets made of straps of iron, sickles, ship chains, pincers and nails. Such a collection might easily be matched in La Tène, or in earlier sites in Asia Minor.

In the time of Charlemagne, iron was rare, costly and used chiefly for weapons and defensive armor. The smith was a highly respected technician; and next to him came the armorer. On one of the Great King's domains, there were only two axes, two spades, two gimlets, a hatchet and a plow of iron. Iron, in the 9th Century, was worth fifty times what it cost at the end of the 19th Century. A thousand years, particularly the last two hundred, had made a great difference in the cost of many things, iron included. According to Boissonade, there was little change in iron technology until the 12th Century. Then there occurred changes in the form of the furnace, in the increased use of water and wind wheels to work the heavy trip-hammer, and, later, the bellows. The relationship of this date to the later Crusades is of great significance. At this time, the iron and steel technology of Constantinople

and Syria were far in advance of Europe and the returning adventurers must have picked up an idea or two with their other plunder.

Even before this, Domesday Book (1086 A. D.), William the Conqueror's income tax list, mentions 5,000 water mills in England, mostly, no doubt, for grain, but some, perhaps, for metal working, and in the 13th Century, near Ypres, there were 120 wind mills to help, in part, the iron industry. In early days "a breast plate was worth six oxen or twelve cows, a sword seven, and a bit more than the horse."

Speaking of the Byzantium Empire, Boissonade says: "—Past masters in mining and metallurgy exploited seams of iron, copper and lead in Asia Minor and Eastern Europe—. They had factories of arms in Thessalonica, at Nicopolis, in Epirus, in Eubea at Athens, etc., and manufactured bows and arrows, lances, cuirasses, sometimes beautifully engraved and decorated."

Thorold Rogers in *Six Centuries of World and Wages*, referring to the manor rolls of Holywell, Oxford, in the 13th Century says: "Relatively speaking, iron was considerably dearer than lead, nearly as costly as copper, tin or brass. It was generally bought, whether it were of English or foreign origins, in bars of about 400 pounds in weight. This was ordinarily purchased at one of the great Fairs and carefully preserved by the bailiff, being sent out to the local smith to fashion into what was needed, and the weight being debited to him on each occasion. Sometimes, but rarely, it is bought in mass. Steel which was employed to tip the cutting edge of iron tools was four times as dear as iron—.

"The high cost of iron explains the fact that cart wheels were frequently unprotected, being made from a section

of a full-sized tree. Again I must repeat that harrowing with a frame set with stout iron pins was unknown or unpracticed. Nearly three centuries after the time on which I am writing (13th Century) when the practice was generally known and adopted, the principal writer on English husbandry states that the agriculturist cannot afford iron toothed harrows in stony ground and recommends stout wooden pegs.

"The share, too, must have been a very slight affair (I judge this from the price), little more indeed than an iron point to a wooden frame, the frame being protected by clouts or plates of iron nailed to it. The principal source of foreign iron was Spain, the produce of which was about one-third dearer than that of home manufacture."

Sheffield, famous in the Middle Ages for her knives or whittles, got her iron from Sweden, via Hull; but fine steel for surgical instruments came from France until the 18th Century, and the Huntsman's invention. Fleams or lancets for blood-letting were often mentioned as of French origin until the dawn of the Industrial Revolution.

Between the 11th and the 13th centuries, there was a stir of vigorous life springing from the commercial contacts made with the Near East during the Crusades. Chalcondyle, clerical Ambassador of the Emperor Manuel of Constantinople, was in Europe in 1,400 trying to borrow money and men to help defend Constantinople from the Turks, already pressing against her walls. Naturally he gave a glowing account of what he saw:

"The natives of Germany excel in the mechanic arts and they boast of the inventions of gunpowder and cannon. About two hundred cities in it are governed by their

own law. France contains many flourishing cities of which Paris is preëminent in wealth and luxury. Flanders is an opulent province, the ports of which are frequented by the merchants of our sea (the Mediterranean) and the ocean. Britain, or rather England, is full of towns and villages. It has no vines and but little fruit, but it abounds in corn (wheat-barley), honey and wool from which the natives make great quantities of cloth."

No great improvements have been recorded in iron manufacture in Europe as early as this, and none indeed were possible while wood and charcoal were so plentiful and the only fuels used for reducing ore, and while society rested on a low plateau of mechanical culture. Coal was used to some extent in working the iron but could not be used with ore because the sulphur made the cast iron too brittle. Primitive furnaces were still used, though the increase of wind and water mills suggests forced draught and the double bellows, known in Egypt and Syria, and still used by native African smiths who may have been borrowed from the *Nile*. The number of small forges in Central Europe multiplied wherever wood, ore and water power were found together and there was even a certain amount of export of surplus iron. Milan, Pavia and Venice, in Italy, Toledo, Valencia and Biscay, in Spain, Dauphine, Languedoc, Guiene and Lorraine, in France, Styria and Carpathia in Germany, and many other towns, are mentioned as being famous at this time for their iron and steel industries. There is no doubt that iron as well as textiles was increasing in demand, and there were many slight improvements in the technique of production because the small workshops were now coming under the early forms of capitalistic management and were being

speeded up. All of which means that pressure was being applied, which, in the end, must find expression in new inventions.

In the twenty-eighth year of the reign of Edward III (1312–37), the export of all iron, whether of domestic origin or imported, was forbidden on pain of forfeiture of double the value. Iron was rapidly advancing in price and those who owned it were suspected of what we call hoarding. As a matter of fact, there was a greater demand than supply. Man had found a new use for iron—the casting of cannon. Hence iron went up in price because a warlike king wanted cannons. So the king blamed the merchants who sold him iron to make cannons.

The demand for iron for shipbuilding, cannon and armor in the 16th and 17th centuries grew so great that England stripped her forests and even allowed the free importation of unworked iron from Ireland, and also of firewood for charcoal, and by this means destroyed Ireland's fine forests which might otherwise have been used for Irish shipbuilding. Early in the 18th Century, England allowed the New England Colonies to ship pig iron, but forbade the Colonies to have either a rolling mill or a triphammer worked by a water wheel. Pig iron was imported from Sweden and Spain and later Russia, but in spite of all these expedients, the iron industry in England languished in the 17th Century for lack of wood or charcoal.

Dud Dudley was born in Worcestershire, in the year 1599, and died in 1684, having lived 85 years, a long life as men measure life, but not long enough to convince a lot of stupid, selfish men that coke was better and cheaper than charcoal to smelt iron. Dudley was the natural son

of Edward, Lord Dudley, the fourth child of eleven illegitimate offsprings the noble Lord had by the same somewhat unconventional but constant mother. She is described in the book of Heraldy in 1663, in a notice signed by Dud Dudley, himself, as, "Elizabeth, daughter of William Tomielson, of Dudley, concubine of Lord Dudley."

Not satisfied with this family distinction, Dud Dudley invented a process by which coke, and not charcoal, might be used to smelt iron ore. His father took out a patent in 1620. Previous to this, Simon Sturtevant had taken out a similar patent in Germany that did not work. Perhaps Dudley knew this.

In 1621, a great flood destroyed Dud's first furnace and the charcoal furnace men vastly rejoiced and spread the report that Dud's coke-iron was inferior. The only proper way to make good iron (as everybody knew) was with charcoal; but charcoal was getting scarcer and scarcer. Still no one would try coke except Dud.

In the reign of James I (the foe of tobacco), monopolies, except with his Majesty, became unpopular. So the charcoal men petitioned Parliament to declare Dud's patent a monopoly and forthwith abolish it. They were partially successful. The life of his patent was reduced to fourteen years.

The charcoal men next started a series of suits which caused Dudley great financial embarrassment. He lost one furnace at Cardley and moved to Himley and was forced to sell his iron to his charcoal competitors at their own price because he had no capital to build a forge. Just why he went on building furnaces is still a mystery. But go on he did, and built a stone furnace twenty-seven feet square, with an immense bellows which turned out seven

tons of iron per week, a gigantic quantity and more than any single furnace in England had produced up to this time.

This was serious: seven tons of iron a week in 17th Century England was "over-production." Business men could no longer trust to floods nor parliaments nor kings for protection from Dudley's coke ideas. The time had come for direct action. So they incited a mob who tore down his forge and cut his great leather bellows into ribbons. A few more law suits did the business. Dud Dudley, fourth natural child of a noble Lord, was thrown or led into a debtors' prison and the charcoal iron men had several years of peace, if not plenty.

But Charles I let Dudley out, and, forming a company with Sir George Horsey, David Ramsey and Ralph Faulke, back he went, into coke furnaces and more and cheaper iron. This looked bad for the charcoal boys. But luck was again on their side. The Revolution came along in which King Charles lost his head, which was not important. But England lost her first inspired iron master, and this was important. He became a Colonel of Dragoons, a general of artillery for Prince Maurice, for which worthy he cast a few small cannon.

In 1660, times had changed again, and bonny Prince Charles II rested gracefully upon the Throne of England, enjoying himself according to his nature. To him Dud Dudley appealed for a new patent to smelt iron with coke. To which the gracious King replied by giving the patent to his friend, Colonel Rogers, who could by no means smelt iron by coke or any other method.

Somewhat before the time of the unfortunate Dudley, a new type of draught had been developed for the German furnace, related, no doubt, to the still earlier Catalan

type. Water was raised by water wind mills and allowed to fall into a box. On one side of the box there was a hole and a pipe leading to the space beneath the fire box in the furnace. On the other side was a second hole, somewhat lower, through which the water ran. Hence the water levels never reached the hole on the side towards the furnace, but the water pressure forced a steady current of air under the fire box and created a greater heat for the smelting of the ore.

The two main iron events which occurred between the 14th and the 18th centuries were the building of the great Norwegian bloomeries of brick and stone, often thirty feet high, and used with charcoal, and the water draught to which I have already referred. The differences are to be sought rather in the added intensity of process rather than in new invention.

One thing only is certain: From the 14th Century on, there is an increasing demand for more and more iron. War plays a part in this demand, but trade and industry compete with war for a share of this metal. This age sees the beginning of cannons and an increase in ship building. There are profits to be made in iron. The demand is constantly beyond the leisurely local methods of production, which, since the ages of Charlemagne and King Alfred, and before, were adequate to the known and fixed demands of a static civilization. The improvement lay in direction and management and in a commercial speed-up. Here we begin to see the introduction of outside commercial control motivated by market demands—modern efficiency, if you will. The product is sold beyond the area of production and made to sell at a profit not of immediate usage. There is competition and, hence, an effort to equalize or reduce production costs.

The comfortable theory of "genius," as an explanation for invention has, of late times, fallen somewhat into disrepute. There is a wholesome tendency to study backgrounds and environmental contributions and not to explain complex invention on the basis of some inexplainable burst of intellectual virtuosity. The inventor is seldom the originator; he is usually the individual who makes a successful use of other men's ideas.

Such a one was Abraham Darby, the man who saved England's iron industry and her place in the sun and the "white man's burden." He was a sort of wholesale tinker who, because of a prosperous business in kitchen pots, needed a cheaper fuel than charcoal to smelt his iron. England had denied coke and a genius in discouraging Dud Dudley. She received coke through the agency of a practical business man trying to solve a practical problem of industry.

In Defoe's *Tour of England,* dealing with the later part of the 17th Century, he speaks of the vast forests, ridicules the idea that England could ever want for charcoal or timber, no matter how much iron she smelted or how many tall ships she built. Daniel had no idea of offending the upper middle classes by suggesting a lack of anything in England. The world was all right. The right side was the top side. There are also today those who ridicule the idea that we shall ever want for petroleum, coal or iron.

But in 1676, there was talk of the many closed mines in Sussex, Kent, Surrey, and in the north of England, because iron was coming into England from other countries who had a greater abundance of charcoal and forests. What would England do in case of war?

Between 1720 and 1730 there were only ten furnaces in

blast in the Forest of Dean. By the middle of the 18th Century, England's furnaces were producing only 17,000 tons of iron from 45,000 cords of wood and importing about 50,000 tons of iron from abroad, including some bog iron of New England.

In the year 1700, Darby, Quaker by avocation and farmer by force of circumstances, went into the business of making iron pots by the old charcoal methods. At first he seems to have had difficulties in producing pots as acceptable as those imported from the Continent. So, wise man that he was, he went to Holland and returned with a knowledge of the Dutch skill in the making of such wares in dry sand moulds, and also with some skilled workers from the enlightened land of the dikes. In 1708, he took out a patent which still may be read by the curious. This patent has much to say about pots, but not a word about coke:

"Whereas our trusted and well beloved Abraham Darby of our city of Bristol, smith, hath by his petition humbly represented to us that by his study, industry and expense, he hath found out and brought to perfection a new way of casting iron-bellied pots and other iron-bellied ware in sand only, without loam or clay, by which such iron pots and other wares may be cast fine and with more ease and expedition and may be offered cheaper than they can be by the way commonly used: and in regard to their cheapness may be great advantage to the poor of this kingdom, who, for the most part, use such ware, and in all probability will prevent the merchants going to foreign markets for such ware from whence great quantities are imported and likewise may in time supply other markets with that manufacture of our own domain, grants the said Abraham Darby the full power and sole privilege to

make and sell such pots and wares during the term of fourteen years thence ensuing."

Business was good, but charcoal was high, and growing scarcer and dearer. Other iron smelters grumbled and complained of foreign competition. The users of iron grumbled even louder at the cost of British iron smelted by the high-priced charcoal. But Darby was the only one who did anything about it. There can be little doubt that he knew of Dud Dudley's experiments with coke. He also had brains and money, so between 1730 and 1735, he perfected a coke oven. Dud's trouble had not been with coke, but with the charcoal minds about him. Darby, as a sound manufacturer and business man, avoided these troubles, and built up a successful money-making industry.

He needed more draught for his coke furnace and he wanted his full heat per pound of fuel. So he worked great bellows with a water wheel. He bought a second-hand Newcome engine to pump up water to run his water wheel. His idea was not "to save the British Industry," but to help Darby make iron pots at a profit. He succeeded.

By 1754, he needed still larger furnaces and, in 1756, "blew in" his first new furnace. He describes his success as follows:

"At top of pinnacle of perfection, twenty or twenty-two tons per week (poor Dud got but seven) and sold off as soon as made at profit enough."

Next, he leased additional properties and built from "profits enough" seven additional furnaces, five "fire-engines" to pump water to turn the wheels that worked his bellows and trip-hammers—a thoroughly capable, keen, energetic, business man, the kind that makes the world fruitful, and, later, endows libraries without books,

or buys old masters and delights the cold hearts of art dealers.

To give some idea of what the development of a satisfactory coke furnace meant to England and the world, in practical terms of iron production, I submit Watkin's chart covering the period between 1740 and 1825, or, eighty-five years:

YEAR		NUMBER OF FURNACES	TONS
1740	Charcoal Iron	59	17,350
1788	Charcoal Iron	24	13,100
	Pit-coal	53	48,800
			61,900
1796	Pit-coal	121	124,879
	Charcoal	None	
1802	Pit-coal coke	168	170,000
1806	" " "	227	250,000
1825	" " "	305	600,000

There came recently into my possession the *Cyclopedia of Useful Arts,* edited by Charles Tomlinson in 1852, glorifying and in part explaining the Crystal Palace Exposition of 1851 at which time the Industrial Revolution seemed to be at its ultimate peak; and containing an introductory essay (not lacking in elegance or interest) on the works of industry of all nations shown at the Great Exposition. It may be recalled that the Crystal Palace was the first building to have iron beams and to use glass in a modern way.

Some measure of the changes which have occurred since the Crystal Palace Exposition and the publication of the *Cyclopaedia* may be gathered from the comments on electricity contained in those volumes. Seventeen years be-

fore this, Michael Faraday had conducted his definitive experiments, proving electricity and magnetism to be the same force. Back of this strange printer's devil, who insisted on reading books of science as well as binding them, were generations of electrical experiments in France, Italy, and, back of all, the Greeks, from whom the word "electricity" is borrowed. Yet in 1852, this is the comment upon electricity in a work dedicated to the "Useful Arts":

"The application of lightning conductors to buildings and ships in order to protect them from the destructive effects of thunder storms is a sufficient reason for introducing into a work on the Useful Arts such an account of the principle of this beautiful science as will enable the reader to appreciate these safe guards. . . ." Next, the telegraph is discussed from the British point of view, a word or so on electro-metallurgy and the magneto-electric machines, and that is all. There is more written in these volumes on the manufacture of candles than on electricity. Yet today it is estimated that $45,000,000,000 of investment may be traced to Edison's inventions which were based, in philosophy at least, upon Michael Faraday's laboratory experiments which scarcely cover the surface of a bridge-table, and his notes which are contained on a single page about the size of that from which you are now reading.

The Crystal Palace exhibition glorifies the second and final age of iron. The building was brilliantly planned, far in advance of its time. As a matter of fact, this architectural age of ours has only just begun to catch up with it, and only a few glass buildings have been constructed in the United States of Owens-Illinois glass bricks. It was an age of iron ships and bridges and rails and loco-

motives. Steel plays only a modest part. It is still only a kind of luxury metal.

Yet of the alloyed steels of our day, so essential to our rapid and powerful machines, there is a hint in the *Cyclopaedia* of 1852. Molybdenum and iridium, chromium and nickel were known then to men of science, but as yet had not been introduced into industry: "When steel is fused with small quantities of platinum of silver rhodium or iridium, its hardness is greatly increased, but these alloys have not yet been used in manufacture."

The immense importance of the coke process may be seen by a glance at a few statistics. In 1825, 600,000 tons of iron were produced in England's coke furnaces. In the year 1851, it reached a total of 2,500,000 tons, but only 18,000 tons of steel, largely from Swedish iron; and England, instead of importing two-thirds of her needs, was exporting about one-half of her production, or 1,200,000 tons. In addition, she was exporting the products of iron including tin-plate, hardware, cutlery and machinery to the annual value of £10,424,139. Besides this, we must consider her ships and many miles of railroads. Darby, the Quaker, in doing good to himself, had done England no harm.

To produce these results, England consumed 7,000,000 tons of ore, 2,700,000 tons of limestone, 13,000,000 tons of coal, and employed between 600,000 to 700,000 workmen. To quote Tomilson again, "Steam power is also largely used."

But the second age of iron did not last long. At the Crystal Palace, Henry Bessemer exhibited a patented sugar cane mill for which he received a prize. In the *Cyclopedia* appears a wood-cut of this machine marked "No. 2095—Bessemer's Cane Press." This machine is

still used, although no longer the most modern device. No one imagined that this skilled designer of machinery was the man who was to end the age of iron and bring in its place the age of steel, the age of steel cheap enough to take the place of iron and bring the Industrial Revolution up to its second peak of mechanical perfection.

Bessemer (later, Sir Henry), master of the second age of steel, was born in a little village in Hertfordshire, son of a prosperous manufacturer of gold chains and steel dies for fine manufacturing. He seems to have been of an ingenious turn of mind, for we find him pointing out to the British Government a defect in the embossing of revenue stamps which made counterfeiting comparatively simple; and also suggesting a means of correcting the defect. From this, he advanced to a machine for embossing velvet, profitable, no doubt, but adding an unnecessary opportunity for bad taste in his age. A most unnecessary addition be it said.

Bessemer was next attracted to the fact that bronze powder sold for almost its weight in gold. After experiments, including microscopic examination of his product, to detect and correct faults, he succeeded in perfecting a machine to make bronze powder. His training in the precious metals and the cutting of dies gave him an understanding of the value of precision in machines.

Bessemer knew that the age of brute force had departed and the age of exactness and balance and the conservation of energy had arrived.

For time out of mind, German craftsmen in Nuremberg had made bronze powder by the same methods the gold beaters of Egypt had pounded out sheets of gold for the coffins of the Pharaohs. It was still, no doubt,

called a "mystery." But the real mystery was Bessemer's.

His confidence in the value of patents was not great. He decided to rely on a secret process. This meant that nobody except his son-in-law and himself should ever see the machine or watch it operate. He made careful drawings of the parts, deliberately mixed up the drafts and sent them out to a number of machine shops with minute instructions. No single machine shop could make any sense out of the drawing sent out. At any rate, the result was one of the strangest factories on earth. It consisted of an engine room on one side, separated by a brick wall from the machine, a windowless room for the machine, another brick wall with a small vent out of which the product poured into waiting drays.

Bessemer now had a product in reasonable demand, selling for about £1 per ounce and costing him about one shilling. The Germans, finding themselves constantly under-sold, just enough to get the orders, tried to reach an agreement with him. Bessemer declined. They next attempted to bribe a workman to sell them the secrets of this 19th Century mystery. In this, after some bargaining, and at a stiff price, they succeeded, and returned rejoicing to their ancient city. But the purchased information did not work. The fact that Bessemer had been his own "disloyal" workman, dressed up for the occasion, may have had something to do with their failure.

Bessemer was among the first, if not the first, inventor to create a modern laboratory with trained assistants. One of his inventions led him by practical necessity to the great invention of the steel converter. He had produced a rifled projectile to be filed from a smooth bore

cannon. The British War Office turned it down. What business had a civil inventor to suggest new ideas to the British War Office? The French were more lucid, if no less final. Cannons of cast iron were not strong enough for such a projectile: steel was too expensive for cannons.

Just as Darby had turned to coke to produce cheap iron, so Bessemer was impelled to invent a method to produce cheap steel.

In August 1856, before an audience of scientists and industrial leaders, Bessemer turned driven currents of air into cauldrons of boiling iron ore. There arose a vast column of sparks and then a sudden tranquillity, a second blast and a second volcano. These sparks were the combustion of silica and carbon and other impurities uniting in oxygen and blowing off and leaving iron pure enough for the making of steel, even steel itself.

The converters were bought with enthusiasm. The golden age had come! Bessemer, of the bronze powder and cane mill and grooved projectile, had blown away three-quarters of the cost of steel and blown in a new age of machines, engines, tools and speed. His name was on all men's lips.

This good opinion was somewhat modified by the experience of some of the purchasers who tried it on iron containing phosphorous. Here it would not work and, to add to their bitterness, it was whispered that Bessemer and his friends had taken options on all non-phosphorous iron ores in England and in Spain. The result was that iron ore fit for his converter was worth twice as much as the phosphorus ore and this meant the closing of many mines, since Bessemer's process, like his bronze mill, was cheaper.

But experience testifies that there are many ways by which a technical cat can be skinned. While this mighty controversy raged, P. C. Gilchrist, a young chemist, and his cousin, a practical Mr. Thomas, went at the problem from the point of view of modern chemical research and experiment. In 1881, they demonstrated a furnace that could handle phosphorus ore. It was at once accepted by the furnace masters of Belgium, France, Prussia, Austria and the United States. It put an enormous value on the Lorraine ore fields which Bessemer's converter had made all but valueless. It almost paid Germany for the war of 1870 and partially compensated France for the war of 1914–1918 and led Hitler's troops back to the Rhine in defiance of the treaty of Versailles.

There have been many modifications and improvements in the processes of steel and iron making and a great development of the ferrous alloys and many engineers and inventors have been involved, but all modern furnaces and the methods of producing iron and steel were developed from the furnaces of Bessemer and Gilchrist.

The recent age of steel had arrived. Let us take a brief statistical glance at the records.

Production in gross tons, 1935.

	IRON	STEEL
United States	21,373,000	34,093,000
Great Britain	6,426,000	9,842,000
Germany	5,267,000	7,586,000
France	3,631,000	3,239,000
Belgium	3,012,000	2,979,000
Canada	655,000	917,000
Alsace-Lorraine	2,067,000	2,926,000
	42,431,000	61,571,000

Of course in the war years, 1914–1918, these figures were exceeded by the United States, Great Britain and Germany by from 30 to 50%, but were reduced in France to about 20% of normal production.

Nations outside of this group include Japan with 1,930,000 tons pig iron, 4,500,000 steel ingots; Italy, iron ore, 1935, 551,000 metric tons, steel ingots, 663,000, rolled steel, 2,128,000; Russia produced in 1930, 4,903,240 tons of pig iron and ferrous alloys; in 1936, 12,310,040.

There is only a point at which the statistics of 1851 exceed those of 1935, and that is in the number of persons employed.

Quantitative comparisons between ages are most easily made by using the yardstick of human life. When the late John D. Rockefeller was born, England, foremost in these matters, produced considerably less than 1,000,000 tons of iron; in the year of his death, England produced about 16,000,000 tons of various forms of iron and steel. In the year 1851, when Mr. Rockefeller was twelve years old, England, iron master of the world, produced 2,500,000 tons of iron and 18,000 tons of steel, with 700,000 workers, or about 3.4 tons of steel per unit of human labor. The year before he died, the United States alone produced more than 55,000,000 tons of iron, steel and ferrous alloys, with 500,000 workers or more than 110 tons per unit of labor.

Five thousand years ago, when men made iron for swords and spears and chains, plow shares, axes and sickles and hoes, they protected themselves from this "Metal of the Gods" by magical rites of purification. I am inclined to believe that they acted with peculiar discretion.

The world has passed out of the last age of iron into the first age of cheap steel, into the present age of ferrous alloys and its entering into the age of synthetic chemical plastics to take the place of many forms of iron alloys—all within the span of a single, long, human life.

CHAPTER XX

TRANSPORTATION

When George Stephenson, in 1830, insisted that the steam locomotive be the sole motive power of the Liverpool and Manchester Railway and that the right-of-way be properly graded to make this possible, he did more for transportation and for the wealth of the world in terms of mobility and cost per ton-mile than any man had done for 10,000 years, or since man in western Asia had trained the first ox to drag a two-wheeled cart. He never claimed to have invented the steam locomotive; men had been using rails for over a century before he was born. He was not the first man to put a steam locomotive on rails. But he was first of all men to comprehend the relationship between steam power in a locomotive, a graded road bed and iron rails, and he had the practical genius to make this combination of ideas fruitful for all men, for all time. He is the father of recent transportation. Back of his "Rocket," the first locomotive on the first modern freight-passenger railway powered solely by steam, lay sixty-one years of experiments of other men with steam vehicles and over a century of rails and much else, including an increased production of iron and precision machine tools.

In 1769, the steam carriage of Nicholas Joseph Cugnot, had run a few miles in Paris, the first vehicle to be propelled by artificial power. Had France but kept up the kind of hard-surfaced roads Rome built as early as the

4th Century B. C. for her tribute, her commerce and her legions, France, rather than England, might have given birth to the Industrial Revolution instead of to her great social drama which was to mark the closing decade of the 18th Century.

The two generations which separate Cugnot from Stephenson contain more new ideas about transportation than may be found in the thousands of years which separate steam vehicles from the first use of domesticated animals to draw wheeled vehicles. But, as a matter of fact, these two periods are technically separated only by the method by which power was produced. The change from animal- and man-power to mechanical power was only an incident in a single broad phase of transportation. Both draught animals and artificial power belong in the era of the wheel. All modern machines and all methods of transportation go back for a starting point to that remote time when man changed the rolling log into the solid wheel with an axle and thus solved one more problem in friction or the waste of energy.

Back of the invention of the wheel in its crudest form there lie those ages in which man was forced to solve his transportation problems without this epoch-making idea. These primitive problems must have arisen as soon as man invented a communal hearth and the organized group hunt to which I have referred in earlier chapters. The great animals he slew with his wooden spears, or caught in his traps, were beyond his unaided strength to move to some more socially convenient location. No doubt he hacked them apart with his stone edges; but, even so, his problem was modified, not solved. For convenience, and for safety, he had to get this meat

and bone, horn and ivory back to the security of the communal fire.

It has been suggested that man may have placed such burdens on the boughs of trees wrenched and hacked off on the spot for this purpose. If this is true, then the bough of a tree was the first vehicle, a discovery, rather than an invention. The contact of the boughs with the surface of the earth was less complete than with the body of the prey. Here man learned his first lesson in the reduction of friction. Moreover, the stem of the bough could be more easily and more firmly grasped than the inert carcass. Many sturdy backs and arms could pull, whereas, only a few could lift or bear. Many hands, then, as now, made light, or at least lighter work. Thus man found out, as usual, by experience, that to haul was easier than to lift or carry. This was valuable knowledge.

The human foot, through ages of evolution, became adjusted to the weight of the man standing upright, but the carrying of burdens under various conditions of terrain and of relatively great weights made some additional support for his feet a necessity or at least a great convenience. Footwear thus becomes an element in transportation.

The types of footwear varied with the nature of travelways, the character and average weight of the burdens, available raw materials, and, as always, with the genius of man. Moccasins, leggings, boots of fur and skin, sandals of plaited grass and raw hide and hard-soled shoes are the result of these necessities and conditions. Among the Siberian tribes and the Eskimos, fur boots and waterproof boots of skin, often with hard soles, reached a very high degree of invention and perfection in execu-

tion. The bast sandals of old Japan, Samoa and New Zealand and our ancient southwest, are peculiarily suited to travel over rough trails in mountain country. The ancient sandals of leather from Peru and Bolivia show as high a degree of invention as those of ancient Greece or Egypt. The wooden shoes or clogs of Europe represent the importance of a familiar and accessible raw material in the determination of types of footwear of our ancestors.

The snowshoe, the ski and the ice creeper studded with ivory spikes are all of Old World origin and associated with winter travel in the Arctic. The snowshoe and ice creeper came into North America in remote times, but the ski not until recent years. The European mountain-climbing shoe, studded with great nails of soft iron, may have been derived from bone and ivory pegs of the ice creepers of archaic Arctic Europe.

The first of all burden-bearers was man himself. The basket, knapsack, net and bag, carried either by shoulder straps, head-bands or without harness of any kind, appear in one form or other in many parts of the world.

But the yoke resting on the shoulders is largely confined to Caucasian peoples. It apparently belongs in the culture pattern which produced the castrated ox and the wheeled cart. This device leaves the hands free and permits of balanced loads. The human yoke seems to bear some relationship to the ox yoke, just as the shoulder straps are similar in principle to the Northern dog harness. There seems to be a relationship between these factors: in both areas, man seems to have transferred his own harness to domesticated animals.

The carrying-pole with balanced weights, and often with elaborate containers, is peculiar to India, China

and Japan and the Malay-Polynesian Islands. The principle of this method is the adjustment of equal weights. The natives often add stones to equalize the burdens.

Baskets, nets, rawhide perfleche cases and bags in great variety, were all used in the New World. Each area and tribe had its own types and the tump line or head-band, shoulder and breast straps were all used. Many of these containers were most ingenious, often, indeed, works of art.

In carrying burdens, often of great weight, the need for periodical rest is obvious. A fine example of an invention for this is the beautiful Papago carrying-net fashioned on a frame work of sticks, the ends of which extend sufficiently so as to rest upon the ground and thus relieve the strain when the bearer is seated.

The litter, a platform of a more or less elaborate nature, attached to poles resting on the shoulders of the bearers, was the first vehicle used to transport man. It occurs in India, Siam and China and the Pacific Islands in remote antiquity. But it is certainly very ancient in Peru and the Mayan Empire, and is illustrated on Peruvian pottery and tapestries and in Mayan stone reliefs, and was also known among the tribes De Soto encountered in the lower valley of the *Mississippi* River.

The litter, of course, presupposes a somewhat advanced civilization. It must have taken quite a time to convince the vast majority of men that they should do the carrying, and to create the conviction in the minds of a very few men that they were ordained to be carried. It is one of the most curious of all social phenomena that man can be taught to take pride in servile occupations. The custom survived well into the 17th Century when the chairs of London became famous and are still

to be seen in museums. At one time, London set rates for these vehicles like our own taxi tariffs, and licensed them, and even attempted some regulation of the evil habits of the bearers.

The bough, torn from a tree and used for the first conveyance, had an interesting technical descendant, common at one time in many parts of the world, but known in the Americas as the "travois." This device consisted of two poles tied together in a point and separated in the center by cross-bars to form an elongated triangle. The apex of this triangle was used for draught and the ends of the two poles at the base of the triangle rested upon the ground. The cross-bars formed a platform to which the burden was secured. This device had many advantages over the bough. In the first place, the two ends of the poles offered less friction than the bough and the elasticity of the poles acted like springs in overcoming the shocks incident upon contact with the Earth. The apex of the triangle fitted over the woman's or the animal's head and offered a rude but effective form of harness.

Various forms of the travois survive today in rural England and Ireland in conveyances used with horses or oxen to drag heavy burdens over rough, soft or hilly ground. Moreover, several transitional forms occur between the travois and the wheeled vehicles in these same regions.

Among the methods of transportation used by the Tagals in the Island of Luzon, there occurs what appears to be a combination of the sled and the travois. The runners extend in front beyond the body of the cart and are connected directly with the ox yoke. From the upper front rails of the cart, two stout poles extend at a sharp

angle far beyond the back of the cart, resting on the ground like the butts of travois poles. Two other types of sleds occur in the Island of Luzon which look remarkably like those used today by the Eskimaux. The two-wheeled ox-cart is also employed.

This might seem to establish the fact that the sled is not of necessity a Northern invention and also seems to connect the travois and the sled in one inventive complex. I am inclined, however, to regard the travois addition as the result of some special necessity of travel in this rather difficult region and the wheeled cart and oxen as obvious Continental intrusions. Great inventions, of a primary nature, do not occur on Islands. Man must have room for his thinking and the widest area for a selection of ideas. I do not believe that the travois is the ancestor of the sledge. The travois poles in a sense are like runners, but the comparison seems a trifle forced. In the travois we are, in my judgment, studying one of those great inventions which have left no technical descendants. To regard it as the prototype of the runner is as unduly imaginative as to consider it the forerunner of metallic springs whose functions it also imitates to a certain extent.

The ski seems a much more probable ancestor of the sled. If man found it convenient to travel over snow on broad runners, why not place skis under his burdens? Indeed, this is what ski users actually do on occasion. To join the skis with cross-bars and build a body or frame for burdens does not require any vast stretch of the imagination. Nordenskiold mentions an old Japanese illustration of an Ainu on broad *Amur* River skis being drawn by a reindeer by a cord about the animal's neck. May not a sled have originated through some such ex-

periments repeated with sufficient frequency to arouse imagination?

There is a somewhat obscure but tantalizing bit of etched reindeer bone from Europe which seems to suggest that the Magdalenean reindeer hunters knew the sled. If so, it is a most venerable vehicle; and, as a matter of fact, there is nothing to disprove the assumption, nor was such an invention either beyond their skill nor have we any reason to question its necessity. Great heaps of animal bones around their caves prove the sled would have been a great convenience. A rock etching recently discovered in Norway shows a mythological rabbit on skis, so we know that the ski is also very ancient. Both sled and ski, apparently, retreat into glacial times.

While the sled seems to have been an invention associated with ice and snow, its use in tropical lands is widespread and of very ancient origin. In Egypt and Assyria it precedes the use of wheels and persists, for the transportation of heavy loads, long after the wheel was used for other purposes. There is no reason why so valuable an idea should have been abandoned when the ice retreated. There is no reason why it may not have spread like other ideas with diffusion.

The modern sleigh did not disappear from our country winter roads until the automobile and the snow plow made it unnecessary and impractical. It was better than the wheel on deep snow. Most travel occurs in Russia during the Winter and the same was true of Colonial America; and in both cases, the sled, not the wagon, was used. Winter snows made fine roads long before man learned the trick of good road-making. The land sled or sledge is still employed for heavy hauling over ground unsuited to wheels even in the over-motorized United States.

On a recent motor trip through the mountains of the South (in the United States), I experienced what I may refer to as a confusing cultural complex, which tends to prove the antiquity of any transportation idea of merit. On a fine, modern concrete road, a technical and most worthy descendant of the Roman highways of the 4th Century B. C., filled with pleasure automobiles and trucks, I saw an ox-drawn sled with wooden runners. And in Williamsburg, Virginia, I came upon a four-wheeled wagon drawn by a harnessed bull! A good idea in transportation is hard to kill.

The ox was the first animal used for heavy traction and his harness was earliest brought to some degree of perfection. But in ancient times, the harness of all draught animals was far from the perfection reached in modern times. During the thousands of years men used the horse, they only used a small percentage of his muscular force because of imperfections in the harness and because, in the early days, they did not know how to protect the feet of their animals with metal shoes. For this reason, man still remained his own favorite animal for heavy hauling. In the first place, he was cheap. You could send out an army and bring back many slaves. He was easy to feed; in fact, he could be made to feed himself. He walked on his feet and thus his hands could be used in place of harness. All that was needed was an overseer with a good whip and a two-pronged goad to get results. The illustrations of Assyrian and Egyptian monuments being drawn into place shows how it was done. It is doubtful if the early Egyptians used rollers under the runners of their sledges. They relied more on the slippery mud and man power than upon rollers. But

there have been recent discoveries of round logs that show a certain amount of wear and the Egyptologists hope in time to prove that these were actual rollers. It seems doubtful that they could have been because of their size. Rollers of such diameter must have sunk in the *Nile* mud and have been useless. There is no pictorial representation in Egypt of the use of rollers.

Recent aerial photography on the Island of Malta has revealed certain grooves on the surface of the land, invisible, except from the air, and it is believed by modern anthropologists that these grooves were worn by the runners of sledges drawn by man power dragging great blocks of stone to be used in the Neolithic tombs. There is no evidence in Malta of the use of rollers.

I do not doubt that the roller is the technical ancestor of the wheel. But the wheel did not grow out of the roller's use in Asia Minor. We have clear and ever-growing evidence that the wheeled carts, wagons and chariots came into this ancient area in a relatively advanced form and already associated with ox and horse culture. The old dolmen tombs of Asia and Europe (could we but know their technical methods of construction) might have a tale to tell both of the sled and of the wheel. The sled and the wheel were first intended to be drawn by man alone. Later, draught animals were invented to relieve man of these burdens upon his strength. But man was only relieved of such burdens as his invention permitted animals and wheels to assume these burdens.

The horse, until modern times, was valued more for swiftness than for strength. Both the riding and the chariot horse were for war rather than for commerce or

industry. The ox was the first creature of draught and his harness was perfected long before that of the horse or other animals.

Professor Abbot Payser Usher in his *A History of Mechanical Invention,* which should be read and digested by all honest men, says: "The extent of the dependence of antiquity upon human muscular efforts has recently been explained by the studies of Lefebvre des Noettes. It appears that the methods of preparing animals for work were defective, particularly as regards horses and mules: *the harness was ill designed and no adequate protection was provided for the feet.* These deficiencies would, undoubtedly, diminish the efficiency with which the animals could work, and there are a number of text references which indicate specifically that the expectation of the ancient fell far below modern standards of average daily accomplishments."

The efficiency of animals, according to the Theodosian Code, was about one-half that of modern vehicles as to the weight of the loads borne. This is particularly true as regards the horse. The harness of antiquity placed the collar too high upon the neck, choking the animal when it exerted its full strength.

As Rome increased the length of her hard-surfaced roads the absence of foot protection for animals became more and more a problem in transportation. It is now believed that metal shoes are much more recent than was once thought and the tendency is to doubt an antiquity for them earlier than the end of Roman power in the West, or about the 6th Century A. D.

Antiquity was not successful in harnessing with efficiency more than a single pair of animals. There were, of course, four-horse chariots harnessed side by side, and

a rare Egyptian picture shows three spans of oxen. But these latter are extremely uncommon in Egyptian art and the efficiency of the methods has been questioned.

For heavy, slow-moving loads, the sled was better than the earlier wheeled vehicles, especially in soft or sandy ground. It took ages to perfect the wheel with the tread of metal and properly constructed to bear great weights and have the proper traction. The wheel was for speed, for relatively light burdens, for mobility, and for long, continuous journeys, rather than draught. Even today, as I have explained, the sled is still favored for certain tasks.

From Egypt and Sumer, from Greece to Rome, the human slave remains the fundamental power-plant both for industry and heavy transportation.

In the centuries which intervene between the fall of the Western Roman Empire and the 18th Century in England (about 1300 years), there is little or no change in the fundamental methods of transportation on land. As a matter of fact, we might say with reasonable accuracy that there had been no change of a fundamental character in methods of transportation since the horse was added to the earlier ox, by intrusions from Western Asia, or at least 3,800 years before the 18th Century. Such changes as occurred were concerned with details such as better breeding of animals, metal shoes, improved harness, increased use of iron, improved and heavier wagons, and better roads. Nothing in western technique of road-building, including recent times, however, can be compared to the well-planned, firmly-built mesh work of Roman roads which joined Rome with the *Thames* and the *Euphrates,* the *Rhine* with the Lybian Desert, along which marched her sturdy legions and

flowed the currents of her land commerce and her tribute. Wagons and carts slowly improved, horses and oxen grew larger, stronger and swifter, and harnesses more mechanically perfect. The changes were, however, in detail, not in principle.

In the time of Caesar, England was famed (if Cicero is to be trusted) for her fine horses and swift, light chariots used in war, but not for her roads. Rome set her an example for a few centuries, but when the Legions departed, the fine, hard-surfaced roads fell into disrepair and largely disappeared beneath the marches, to the later delight of the antiquarians. Still, some models existed later to inspire Metcalfe, Telford and Macadam; and, still later, the engineers who created our fine highways of concrete and steel. But as late as the middle of the 18th Century, in the midst of the Industrial Revolution and world ocean-borne trade, England's roads were not only very bad, but worse even than the bad roads on the continent and the roads of the United States were beneath contempt. All roads may have led to Rome, but all roads do not even yet possess the sturdy quality of Roman roads.

Towards the later part of the 18th Century, people were still travelling almost as Chaucer's pilgrims had in the 13th Century, the sturdy and strong on horseback, the aged and infirm on litters, the poor in freight wagons, the rich in their own carriages—with running footmen to prop them up at dangerous places in the road. But the wise folk stayed at home. Post horses cost a shilling per horse per mile; armed guards rode beside the driver to protect the mail from highwaymen; and the judicious traveller carried a brace of pistols. Travel and war were rated as equal hazards. But in spite of

these difficulties, the mail coaches got along at a rate of eight miles an hour, including stoppages—an incredible speed, all things considered. (These figures are supplied by the coach companies, which may account for their optimism).

Daniel Defoe, who wrote his *A Tour Through England and Wales* in the 17th Century, very prudently went on horseback. He describes a stirring commercial life, much wealth—and terrible roads. He mentions a lady of quality being hauled to church in her coach by three span of oxen, the relatives of those, perhaps, who once hauled the Sumerian wagons. This proves the piety of the lady, no doubt, but is also a commentary on the roads.

For heavy goods—iron, coal, clay, grain, etc., there were great wagons, drawn by six or eight horses, with immensely broad and strong wheels. The costs were heavy, the speed about two miles an hour, and much of the time was spent stuck fast in the mud.

Metropolitan traffic in London had, before the middle of the 17th Century, become a serious problem. Hackney coaches had been introduced from the Continent in 1625. At first, there were only twenty such useful, if luxurious, vehicles. Craig says in his *History of British Commerce:* "Ten years later, however, we find the King (Charles I) publishing a proclamation in which he declares that the great number of hackney coaches of late seen and kept in London, Westminster and their suburbs, and the general and promiscuous use of coaches there, were not only a great disturbance to his Majesty, his dearest consort, the Queen, the Nobility and others of place and degree in their passage through the streets, but the streets themselves were so pestered and pavements so broken up, that the common passages were

hindered and made dangerous; and besides, the price of hay and provender made exceedingly dear."

In 1634, sedan chairs were introduced to add to the confusion, and in 1635, King Charles tried to establish a postal service of riders who were supposed to go and come from Scotland in six days. But this great achievement was not consummated until 1649 or thereabouts.

The famous English traveller and experimental farmer, Arthur Young, in his *Southern Tour of England in 1768,* has this to say of the roads of his native land: "Of all the roads that ever disgraced this kingdom in the very ages of barbarism, none ever equalled that from Bellericay to the King's Head at Tilbury. It is for nearly twelve miles so narrow that a mouse cannot pass by any carriage. I saw a fellow creep under his wagon to assist me to lift, if possible, my chaise over a hedge. The ruts are of an incredible depth. The trees everywhere overgrow the road, so that it is totally impervious to the sun, except at a few places. And to add to all the infamous circumstances which occur to plague a traveller, I must not forget eternally meeting with chalk wagons, themselves frequently stuck fast till a collection of them are in the same situation, that twenty or thirty horses may be tacked to each to draw them out one by one."

Birnie, speaking of the 18th Century transportation, states: "In England it cost 20s. to convey a quarter of wheat a hundred miles by road, while the expense of carrying coal to Manchester from the mines at Worsley, eleven miles away, was sufficient to double its price."

The second half of the 18th Century witnessed the dawn of improvement in European roads. In 1747, Louis XV, in France, created a corps of engineers and

ordered that all peasants should give thirty days' labor free on the roads each year. This outrageous burden was known as the *corvee,* and later was bitterly complained of in the Revolution. But at the close of the 18th Century, France had 25,000 miles of fine roads which were the envy of Europe. At least France got some roads out of her tyranny.

In England, in the 16th Century, and up to late in the 17th Century, roads were cared for by the parishes; which meant, of course, that they were not cared for at all. Then the idea of toll roads was turned into an act of Parliament, but each road required a special act. It was not until the reign of Charles II that the first toll gate was erected and toll gates did not become common until the latter half of the 18th Century. Between 1760 and 1774, however, no fewer than 452 local turnpike acts were passed. The travelling public resented these tolls and often destroyed the gates and abused the keepers. In this latter part of the 18th Century, this was made a felony punishable by death. Up to the 20th Century, England relied upon toll charges to keep up her roads, until taxation on motor cars made this unnecessary as well as unpopular. No account of transportation, however brief, can avoid some mention of canals. In modern times, the Italians and the Dutch were leaders in this field and canals around rapids, and even as short-cuts, were notable features of the trade of the Middle Ages. The great age of canal building in England corresponds with the growth of her industries in the latter part of the 18th Century. The first great canal was opened between the mines of Worsley and Manchester, in 1761, and was built by the untaught genius of Brindly. In a later decade of this century there was a rage for canal

building, and England was covered with a network of man-made waterways. This mania spread to England's American colonies and inspired Washington's dream of a *Potomac* and *Ohio* Canal and the great Erie Canal which was started in 1792 and was finished in 1825 and which made New York City the great port of the opening West.

In 1820, Elkanah Watson (Albany, N.Y.) published certain observations on canals in the United States. "In the winter of 1785, I spent two days with the immortal Washington at Mt. Vernon. His mind being intently settled on the prospect of connecting the western waters by canals with his favorite *Potomac,* and improving the navigation of the *Monongahela* and other branches of the *Ohio;* principally with a view of diverting the fur trade from Detroit to Alexandria instead of going to Montreal, as heretofore. He permitted me to copy notes from his journals and estimates on this sublime plan." Mr. Washington had planned the city of Alexandria and had a firm belief in the value of real estate in that city. "I am inclined to believe," continues Watson, "that, should the western canals be ever made, and the *Mohawk* River ever become in one sense, a continuation of the *Hudson* River, by means of canals and locks, it will most clearly obviate the necessity of sending produce to market in winter by sleighs. On the contrary, it would be stored on the margin of the *Mohawk,* in winter, and be sent in the summer months to be unloaded aboard vessels in the *Hudson.* Whenever this glorious state of things shall exist, western farmers will find it infinitely to their interest to substitute oxen for the transportation of their produce in place of horses."

When this was written, steamboats were already a

recognized success as far as river transportation was concerned. The date of publication is curiously close to Stephenson's first successful rail experiments, and is eight years after Stevens, in America, made his famous prophecy regarding steam locomotives, and when locomotives were already in use on English coal railways. It is curious to see the old ox of Central Asia still so highly praised when the steam locomotive was already known.

The Romans knew and used Newcastle coal for heating the damp villas in Britain. But it was not until the 13th Century that coal began to play a part in British industry and social life. "Sea Coal Lane (between Skinner Street and Farrington Street, London)," says Craik in his *History of British Commerce,* "is mentioned by that name in a charter of the year 1253." Regulations are laid down for the sale of coals in the statutes of the Guild of Berwick—upon Tweed which were established in 1284. It seems probable that some of this coal was used for industrial purposes as the following incident seems to prove: "This same year (1306)," says Maitland in his *History of London,* "sea coals being very much used in the suburbs of London by brewers, dyers and others requiring great fires. The nobility and gentry resorting thither complained thereof to the King as a public nuisance, whereby they said the air was infested with a noisome smell, and a thick cloud, to the great endangering of the health of the inhabitants; wherefore a proclamation was issued strictly forbidding the use of that fuel. But little regard being paid thereunto, the King appointed a Commission of Oyer and Terminer to inquire after those who had contumaciously acted in open defiance of his proclamation, strictly commanding all such to be punished by pecuni-

ary mulcts: and, for a second offense, to have their kilns or furnaces destroyed."

In spite of this royal proclamation, in 1325, we find mention of coal trade between Newcastle and France and the first leases of coal works in the neighborhood of that town of which there is any account, are dated a few years later.

The early use of coal, as of wood and charcoal, is concerned with heat for industrial purposes for forges, smelters, kilns and furnaces. It is not associated with power until man had changed steam from an elegant and amusing scientific problem into a drudge-of-all-work.

Let me now digress for a moment from the story of artificial transportation, to sketch an outline history of steam, the first "power" man created.

In Alexandria, Egypt, in the 2nd Century of our era, while Rome was still mistress of the world and making a good job of it, scientists (natural philosophers as they were called) were studying the nature of steam. They had no idea of applying it to any useful purpose. It was to them what electricity was to the philosophers of the 18th and early 19th centuries—a scientific toy. All that Hero and Ctesibus did was to cause jets of steam to issue from brazen lips, wine and water to gush forth, and doors to open mysteriously and organs to play and the heads of idols and idol-worshippers to turn. Pagan elegance had begun to feel the competition of a peculiarly rugged type of Christianity. It needed the aid of scientific men. And nobly did the learned philosophers respond with a device called "aerophile," which men a few centuries later came to know as the steam turbine.

If the germ of an idea is of importance, then we owe the giant steam to the scientific chicanery of a pagan

temple in the 2nd Century of our era. Had the philosophers of Alexandria realized what force they had created, and had they applied it to mechanical devices then known, the entire course of history might have been changed. A little more iron, a few less slaves, a little greater need for power and the thing might have been accomplished. But the idea was destined to lie fallow for more than a thousand years.

Nine years after the fall of Constantinople had shaken the world, as the phrase runs, a modest German monk, of a mathematical turn of mind, rode over the Alps to learn Arabic from the wise men driven from their ancient halls along the Hellespont by the all-conquering Turk. Nothing, or nobody, trembled this time, unless it was the monk himself. Yet his journey was the greater event of the two.

He ardently desired to translate the fragments of Hero's *Pneumatica,* preserved in the difficult Arabic script. With becoming modesty, he accomplished his self-appointed task and went the way of all flesh. At last, in 1575, his work was published in sound clerical Latin, the language of science of that day. It was a timely publication and was read by the learned men of that day with interest and profit.

There followed the brilliant experiments of Porta and Cardan and Branca and the vacuum cylinder of Otto Von Guericke and Papin's valve, and the work of Solomon DeCaus who, first of all men, proved that steam was something more than over-heated water.

Practical men the world over were busy about their practical affairs. Rising merchants contended with falling nobles for power and position. Kings made gestures at kings, Catholics and Protestants converted each other

at fiery stakes, and ships with iron cannons sailed the seas seeking loot, commerce and colonies. No one paid any attention to the birth of the giant, Steam. Why should practical men concern themselves with the vapor of heated water?

Edward Somerset, later known as the mad Earl of Worcester, is the first English inventor in the modern history of steam. He had a gift for science, was fond of scientific literature, had travelled extensively on the Continent, and must have been familiar with the treatises of Solomon DeCaus and others. But his genius was his own and of a marked character. He began his experiments at Raglan Castle with a steam pump, in 1628, and was building a steam fountain at Vaux Hall, in 1643, when Parliament confiscated this property because of his royalist sympathies. Raglan Castle was besieged by the Parliamentary force and, after ten weeks of fighting, was captured on August 19, 1646. After some years spent in exile, Worcester returned to England and was promptly put into the Tower of London as an example to all the king's men. While in prison, he set down a list of his inventions from memory—the memory of a weary old man much buffeted by the world. The tale of his memoirs has a certain wistful quality as of glories departed: "A century of names and scantlings of such inventions as at present I call to mind and have tried to perfect, which (my former notes being lost) I have, at the instance of a powerful friend, endeavored now in the year 1655 to set these down in such a way as may sufficiently instruct me to put any of them in practice."

In 1663, "justice" was done the aged Marquis; he was granted a 99 year patent for his fire-commanding engine. His little experience with the divine right of kings and

the force of Puritan Parliaments had cost him £40,000. But it cost England more than this. War, prison, exile and the years had broken this curious intellect. He made a new pump, but after 1670, we hear no more of the matter. But the idea could not be smothered either by a worthless king or by a stiff-necked lot of Puritans who tried in vain to make his pump work for them without its master.

Some part of Worcester's ideas came to life again in Thomas Savery's steam pump for which a patent was granted in 1698 and subsequently extended for thirty-five years. In 1702, this engine was described in a pamphlet entitled *The Miner's Friend.* Between 1717 and 1719, Savery formed a partnership with Thomas Newcomen and, with the aid of a gifted mechanic, John Smeaton, produced a steam mine pump which was standard equipment in British mines for over seventy years.

It will not detract from the reputation of James Watt to disclaim for him the "invention" of the steam engine. He no more invented the steam engine than Edison invented electricity or Ford the automobile. He never, indeed, made any such claim. Like many others, he improved the machine as he found it and, more important, he made it "pay."

He seems very like the kind of boy who today might work his way through one of our great technical schools and become a Doctor of Science, teaching others; or he might have vanished into some vast laboratory where an unduly minute division of labor and Shylock-like contracts concerning patents, stifles genius. Watt did better: he went into business and became a wealthy man for his time and a man of power in his generation.

James Watt was most fortunate in the selection of his father. This worthy Scotchman was a carpenter and, by natural evolution, an undertaker, a bailie (a sort of sheriff), ship chandler, merchant and contractor. Life with such a parent could scarcely have been dull. But when Watt was seventeen he had had enough. He went up to Glasgow and became an apprentice to an instrument-maker, that is, a highly skilled mechanic. But this particular instrument-maker was far above his trade. He wasted no time on instruments, but made fishing rods for those who knew the delights of Scottish salmon and trout streams. Watt was not impressed. He went to London and bribed a master mechanic with £20. to teach him in one year what he should have taken seven years of apprenticeship to learn. After this, he returned to Glasgow to set up shop. But the Gild of Hammersmen would not allow anyone to practice their mystery unless he had served a seven-year apprenticeship or happened to be the son of a Burger of the City of Glasgow. Thus the restrictions of the Middle Ages, surviving in the midst of the Industrial Revolution, literally threw young James, the hopeful instrument-maker, into the academic arms of the University of Glasgow and into association with Drs. Dick and Black, then turning their minds towards the scientific consideration of steam, the theory of latent heat, and familiar with the literature of the previous experiments on the continent in steam. And thus the right kind of boy, with the right kind of experience, at the right time, was cast in the right environment. Fate has her generous moments.

Watt's great opportunity was presented when he was asked to repair a Savery-Newcomen pump which was a part of the physical equipment of the University. When

he finished the job, his education was complete. He had learned not only about steam engines, but how to economize steam. His practical improvements on the older engine laid the basis for modern steam equipment and modern economies in the use of steam and the saving of heat.

James Watt's "improved steam engine" had a profound influence upon the rising industrial life of his age and, indeed, upon our own. Among his achievements may be numbered a more efficient, more powerful, more economical steam engine to clear mines of water (without which English coal would have had little value) ; steam pumps to raise water into mill ponds to work water wheels for forges, and to operate bellows for furnaces. According to the accurate Baines, Bolton and Watt made the first steam engine in 1785 for Messrs. Robinsons in Papplewich, Nottinghamshire, to operate the machinery for a cotton mill. Watt's stationary engines, with endless chains or hawsers, were used to drag coal buckets out of mine pits, and coal cars along tramways when the grades were too steep for horsepower. He believed that steam engines might be used to move various burdens just so long as the engines themselves remained stationary. When his patents (which ran from 1769 to 1800, and included all engines in which steam was condensed in a separate vessel) expired in 1800, he retired a wealthy man: but continued to use his great and deserved influence against all such new-fangled ideas as steam carriages or locomotives.

Since the 17th Century there had been a rising demand for better, swifter and cheaper land transportation. During these times, the ocean going ship had grown larger and faster, and the improvement in the science of naviga-

tion had made long commercial voyages matters of relative precision and regularity. The commerce of the world, and, hence, the world's wealth, had increased beyond credence. But all of these improvements began and ended at salt water ports. Inland transportation had remained dormant, and was inadequate to the rising demands of industry and commerce. The iron and textile industries on the continent, but especially in England, had been vastly increased to supply the internal demands created by this new wealth; but more especially to transport in the tall ships the manufactured exports, which supplemented the gold and silver drawn from Spanish America, and used to maintain a "balance" in Oriental trade. The engines of Savery and Watt, Darby's coke furnace, and the textile machines (since they had vastly increased production), added further confusion to the problems of inland transportation. Something more was needed than pack animals or heavy carts and wagons; something better than the common roads of that era; something more extensive than the short coal tramways from mines to waterways. Transportation must go far beyond the needs of coal.

This condition led to a certain improvement in the construction of common roads, especially in France; a rebirth of canal building on the Continent and in England, and later in the United States.

It was the great age of ocean sail, and to sail men first turned for a solution of their problem, i. e., cheap land transportation. There are interesting accounts of sailing wagons in Wales, in Holland, and one account of an incredible monster sailing wagon, with a forty foot spar, navigating through the narrow streets of Paris. This idea is by no means impossible, if, for the moment, impractical or dormant. Fuel-oil and coal may in time, indeed, must

in time, grow too expensive; every gallon, and ton, taken from the bowels of the earth brings society nearer to the inevitable law of diminishing returns due to waste of irreplaceable raw materials. There are level desert areas with steady trade winds which may at some distant day see a return of interest in sailing wagons.

But, in a later portion of the 17th, and the early 18th centuries, men's minds had been captured by the idea of steam. It was at this time a scientific novelty, just as electricity became in the late 18th and early 19th centuries, and was regarded as the sovereign cure for all industrial and mechanical problems. As I have said, Italy and Germany and France, no less than England, had a part in this matter, although fruition was England's share.

Sir Isaac Newton, in 1680, suggested a theory of a steam carriage to be propelled by an engine strangely resembling (in description) the reaction steam turbine of that not unworthy Greek, Hero, of Alexandria. This proves the classical soundness of Sir Isaac's studies. But a theory, no matter how distinguished the author, nor how brilliant the theory, is not a machine to perform a service. Like Leonardo da Vinci's later drawings of an aeroplane, it was brilliant and interesting, but, also, like the idea of the great Florentine, it would not work.

It was not until the latter half of the 18th Century that a steam propelled vehicle makes its first appearance in the technical history of man, that animal who made curiosity "pay." In the year 1769, there puffed and belched, shook and rattled, and, to a certain degree, moved forward on the streets of Paris, the steam carriage, or tug, of Nicholas Joseph Cugnot. No stranger sight had ever before astounded the citizens; none of greater portent

than this "monster" which divides the ages of transportation between men and animals dragging wheeled vehicles, and wheeled vehicles propelled by power generated from over-heating water with fire or other mechanical man created power. This event can neither be separated from the long ages of transportation which lay behind it, nor from the brief age of steam which lay ahead. It was a "turning point," an episode of destiny. It made two short trips; on the first, it demolished a stone wall in the garden of the Arsenal; on the second, it turned over and chanced to kill a curious, but otherwise unidentified citizen. The good people of Paris were accustomed to be run over and slain by horse-drawn-vehicles; this was in the way of "nature"; but they did not propose to be killed by new contrivances. So, Cugnot's "monster" was hauled back into the Arsenal where it still stands, not, I trust, without due admiration from all honest men. It is worthy of remark that this first attempt at a power propelled vehicle had a shaft and gear drive—more nearly like the modern automobile than the somewhat later efforts of steam carriages.

Cugnot's "Idea" was to be granted two more chances. Banker Roland, one of the ill-fated Girondists, was ordered by the Revolutionary Assembly to inspect it. He reported favorably, but no action was taken. Later, Roland and his companions rode to the Guillotine in horse drawn carts; not steam carriages. Still later, a famous Master of Artillery viewed it as a possible means of dragging cannon. But Napoleon was then filled with his plans for the campaign in Egypt, and dreams of the conquest of the Orient. He saw merit in the steam tug, but had no time for experiments. Had Napoleon's cannons been dragged by steam tugs through the mud at the Battle of

Waterloo, the 18th of June might have been a French, rather than an English "day we celebrate."

Cugnot was paid a pension of 300 livres until the Revolution abolished all pensions and privileges in favor of a new set of "rights." Surely this was a modest recompense for such an Idea!

In the same year a linen draper, Francis Moore, took out an English patent for a steam carriage. This vastly aroused a friend of Watt's, a Dr. Small, who wrote urging Watt to hurry his long promised invention of a "fiery chariot," to whom Watt made the following reply:

"If Linen Draper Moore does not use my engine, he cannot drive them (his carriages). If he does (use my engine), I will stop him."

The year before Watt's patent was granted, Dr. Small, his admirer, introduced to him a certain Richard Lovell Edgeworth, as a "young gentlemen of fortune, mechanical and indefatigable, who has taken a resolution to move water carriages by steam."

Watt seems to have turned Edgeworth to other matters, for, in this same year, the young gentleman received a gold medal from the Society of Arts for a paper on railways.

He suggested four elevated roads out of London; two for slow freight carts and wagons; two for swift stage coaches, and gentlemen's chaises. In 1812, he renewed his plan and added stationary engines (the kind built by his friends, Bolton and Watt). He is said to have labored for forty years over these matters and to have made over one hundred models. Perhaps the modern overhead drives now saving modern cities from automobile congestion may in some slight degree be traced to his ideas.

Watt, as I have said, was not interested in such chi-

merical ideas as "steam carriages." But steam carriages were of interest to many other men. Dr. Erasmus Darwin, a bustling and prosperous physician, was an amateur of distinction in matters of steam, and addicted to poetic expression of a sort, as the following lines indicate:

> "Soon shall they arm unconquered steam for
> Drag the slow barge or drive the rapid car
> Or on wide wings expanded blow
> The flying chariot through the fields of air."

This poem is dated 1779, twenty years after Cugnot's experiment.

William Murdock was Watt's most brilliant mechanical assistant, one of those rarely gifted tool users who have added so much to the world's comfort and wealth and other men's profits. It was a matter of deep distress to Watt that such a man should waste his time on "fiery carriages." In spite of this disapprobation, Murdock is believed to have gone so far as a working model. So Watt wrote to his partner Bolton:

"In the meantime I wish William (Murdock) could be brought to do as we do, to mind his own business in hand and let Symington and Sadler throw away time and money in hunting shadows." When, however, in 1786, Symington and Sadler attempted a steam carriage, Watt interrupted their shadow hunting with a very real court order. Two years later, Symington is said to have built an engine for a paddle boat, and, in 1801, or 1802, installed such a power plant in the famous "Charlotte Dundas" which drew coal barges through Dalswater Lock for the Duke of Bridgewater. An order was placed by His Highness for several of these engines, but, dying before delivery, his executors promptly cancelled the

order, took the "Charlotte" out of commission and themselves out of the "Hall of Fame."

The Charlotte Dundas is generally believed to have been the first boat ever propelled by steam. Most later steam engines "invented" in America are suspiciously English, often, indeed, directly borrowed from British models. But the case of John Fitch does not fall under this heading. In justice to the memory of a brave and tragic man his claims deserve consideration. S. Dunbar in his excellent "History of Travel in America," gives a record of five experiments which Fitch made between 1785 and 1797, some of which were seen by independent and credible witnesses. The time and the technical environment were against him. He died in the border state of Kentucky bitter and disillusioned, of a purposeful over-dose of opium in the year 1798. He cannot be honestly denied his place among those men who first harnessed steam.

Richard Trevithick, was a pupil of William Murdock and consequently, "a hunter of shadows." In 1803 he produced a steam carriage and took the wonder to London and exhibited it on a circular track for the modest price of one shilling, which included a ride for the more reckless in the audience. Among these, fortunately for the records, was a man of science, Sir Humphry Davy, once the Master of Faraday, father of modern electricity who commented on the experience in the following words:

"I shall soon hope roads in England are haunts of 'Captain' Trevithick's dragons—a characteristic name."

Had the roads of England at this time been better, as good say as the old Roman roads, this wish might easily have been granted. Captain Trevithick, as Cugnot before him, had not unworthy followers, as Walter Han-

cock proves in his "Narrative of Twelve Years Experiments in Steam Carriages, 1824–1836, Demonstrative of the practicability and advantage of employing steam-carriages on Common Roads; with engravings and descriptions of the different steam-carriages constructed by the author, his patent boiler, wedge wheels and other inventions."

Such a work was published in the year 1838 by John Weale of High Holborn, and J. Mann of Cornhill, and lies before me even as I write to this, perhaps, incredulous audience. It is a good, lean and lucid work, not lacking in the evidences of veracity. In the Preface, the inventor remarks, "The author of these pages believes he should offend alike between truth and genuine modesty, were he to yield to any of the steam carriage inventors who have appeared in his day, in a single particular of desert; he began earlier, with one abortive exception (perhaps Cugnot's), and has preserved longer and more unceasingly than any of them; he was the first to run a steam carriage *for hire* on a common road, and is still the only person who has ventured in a steam vehicle to traverse the crowded streets of the metropolis (London) at the busiest periods of the day. His steam carriages running on the public roads have been his best witness.

"The attention of the author of this narrative was first turned to the subject of steam locomotion on common roads, by the circumstance of his having invented in 1824 a steam engine of a very novel description which seemed to him peculiarly well adopted to the purpose. Metallic substances enter, but in a very limited degree, into the construction of this engine, and in the prime movers are almost entirely dispensed with; instead of iron or copper, an article is used which is not only much lighter, but free

from all liability to fracture, and, hence, both a great reduction in weight and great capability of resisting tear and wear, two of the most important elements in a steam carriage for common roads. . . ."

The flexible steam receivers "were composed of several layers of canvass firmly united together by coatings of dissolved 'caoutchouc' or India rubber and thus enabled to resist a pressure of sixty pounds of steam upon the square inch." He also describes, and clearly illustrates, a tubular boiler intended to remove the danger of explosions.

The work contains careful drawings of his several machines which seem above suspicion. But the surest proof of his veracity lies in his description of how the 19th Century public received "the steam carriages." This is too much like the early 20th Century public's attitude towards the automobile to have been a literary invention in a 19th Century book: "All had heard," says Hancock, "something of a scheme for riding by steam, but most persons with much the same degree of incredulity that we now listen to tales of *journeying in the air*. The writer was the first, or with the first, to offer to all who choose to come and see, ocular demonstration of the practicability of the thing—to exhibit in the face of day, and on the public highways, a carriage propelled by steam. But though this was evidence not to be gainsayed, it was not a little mortifying to see how the force of it was evaded. Some would admit frankly that the carriage worked well; but expressed as frankly their decided conviction that it would never answer for a continuance contrivance. Others would depreciate its performances, exaggerate its defects, and exult, as it were, in every instance of accidental stoppage. If requiring temporary accommodation, through

the failure of some part of the machinery, a circumstance, naturally enough, of frequent occurrence in this early period of his locomotive career, he usually experienced the reverse of kind or considerate treatment. Exorbitant charges were made for the most trifling services, and important facilities withheld which it would have cost nothing to afford. If, again, he happened to be temporarily detained on the road from want of water, or from any other cause, he was assailed with hootings, yellings, hissings, and, sometimes, even with the grossest abuse. It is true this latter description of treatment proceeded chiefly from the 'rabble'; but he regrets being obliged to add, not exclusively so. Great obstructions were also continually experienced on those occasions from wagons, carts, coaches, vans, trucks, horsemen and pedestrians, pressing so close on the carriage as sometimes to preclude the possibility of moving. Altogether the writer's situation was in general anything but agreeable; often most irksome and irritating, sometimes very hazardous."

Hancock only claimed his carriages to have been the best, and the first to establish a regular omnibus service. He himself speaks of other and similar ventures. In the 1936 Christmas number of *The Illustrated London News* appears a spirited article, "Ancestors of the Motor Car," with colored reproductions of various steam carriages taken from the collection of Andouin Dollfus. These illustrations include the "Pro tèe" of Charles Dietz, hauling a stage coach along the Champs-Elysées in the year 1834; the somewhat hypothetical, but elegant, steam carriage of W. H. James (with tubular boiler), burning charcoal and coke, and dated 1828; a sketch of Mr. Gurney's new steam carriage which had the great honor of bearing the meager person of the Duke of Wellington and other peo-

ple of distinction at Hounslow on August 12, 1829. And there was a convincing colored print of Walter Hancock's famous trio "Era," "Infant," and "Autopsy," which between the years 1832–1834 did maintain an omnibus service, more or less regularly, between Moorsfield and Paddington in the city of London.

Steam carriages were driven off the common roads of England by a combination of circumstances. The roads were not good enough; after 1830 the steam railroads offered too great competition, the bitter opposition of the stage coach and wagon and freight lines; the owners of inns, and those who raised horses or sold horse fodder; and the companies who held the mortgages on the toll roads—in fact everyone seemed against this venture. Yet in spite of all this opposition and the mechanical difficulties inseparable from new machines, more than a start was made—the modern motor car does not lack for worthy ancestors. Steam may at some not too distant future return to the roads: water and fire will last longer than petroleum.

The solution of the great problem of inland transportation was not to be found in any single invention, no matter how brilliant, but in a composite of many separate inventions and the ultimate association in one pattern of railed tramways and steam locomotives in what we know today, and, for the past Century, as the Railroad.

The story, the early story, of the railroad is the history of coal. The Romans had mined coal when England was the most western province of the Empire as is proved by the cinders in the ruins of many an ancient villa. Coal has been carried in baskets on the bent backs of slaves, in panniers, on pack horses, by ox- and horse-drawn two-wheeled carts and four-wheeled wagons; on common

roads and on tramways with wooden sleepers, on strips of iron and ultimately on iron and steel rails.

A somewhat dubious Mr. Beaumont is believed to have invented wooden rails in coal regions around Newcastle in the early 17th Century, to have lost 30,000 pounds and to have "ridden home on a light horse."

By 1672, we come to a little clearer going. Roger North, brother of a Lord Chancellor, described a wooden railway he had seen at Newcastle during the reign of Charles II, as follows:

"The manner of the carriage is by laying rails of timber from the colliery down to the river exactly straight and parallel, and bulky carts are made with rowlets (little wheels or rollers), fitting these rails, whereby the carriage is so easy that one horse will draw four or five cauldrons of coals." The Newcastle cauldron weighed 5,936 pounds so that one horse (according to North), hauled eight or nine tons. But, even at that early date, North mentions the bitter complaints of the coal mine owners at the charges exacted by the land owners for the rights-of-way of the tramways from mine to river barges. Even then society placed a penalty on "improvements."

Arthur Young, in his *Six Months Tour of England,* written at the close of the 18th Century, has this to say concerning these matters:

"The coal wagon roads from pit to water are great works carried over all sorts of inequalities of ground, so far as the distance of nine or ten miles.

"The tracks of the wheels are marked with pieces of wood let in the road for the wheels of the wagons to run on, by which one horse is enabled to draw, and that with ease, fifty or sixty bushels of coals."

The wooden rails were next covered wtih strips of sheet

iron; the wheels were concave, the rails convex, "worked like pulleys."

Cast iron rails were known as early as 1738, and in 1767, the Coalbrookdale Iron Works in Shropshire cast five or six tons.

In the year 1776, an ingenious but ill-advised John Curr designed and built for the Duke of Norfolk's colliery near Sheffield a tramway with flanged cast iron rails.

Labor bitterly opposed the idea. If it made coal transportation easier, it would cause unemployment and reduce wages. So they tore up the tramway, burned a coal pocket for good will, and earnestly hunted the inventor with the intention of hanging him to encourage virtue. But so sound an idea could not be long delayed. In 1789, William Jessop constructed a railed tramway and this time the wheels, not the rails were flanged, and here we have the first appearance of the modern method of preventing cars from slipping off the rails.

Charles Francis Adams in his "Railroads, Their Origin and Problems," written in 1888, says:

"Everyone who has ever looked into a school history of the United States knows something of the Quincy railway of 1826. Properly speaking, however, this was never, or at least until the year 1871, a railroad at all. It was nothing but a specimen of what had been almost from time immemorial in common use in England under the name of 'tramways.' Indeed it is a curious illustration of the combined poverty and backwardness of America, at that time, that so common and familiar an appliance should only then have been introduced and should have excited so much interest and astonishment. This road, known as the Granite Railway, was built by those inter-

ested in erecting the Bunker Hill Monument for the purposes of getting the stone down from the Quincy quarries to a wharf on *Neponsit* River. . . . The whole distance was three miles and the cost of the road was $34,000. At the quarry end there was a steep inclined plane up and down which the cars were moved by a stationary (steam), engine. . . . Down this road two horses could draw a load of forty tons, and thus the expense of moving stone from quarry to river was reduced to a sixth part of what it was while the highway alone was in use."

In 1827 an anthracite coal company built a railed tramway for horse-drawn cars with stationary engines for grades and partially operated by the force of gravity for its mines near Mauch Chunk, Pennsylvania. This investment had paid for itself by the year 1830.

Watkin in his brief memoir on rails, in 1891, calls attention to the fact that horse cars on rails were more economical than steam locomotives for urban and suburban passenger transportation in the concluding decade of the last century, long after the United States had far passed the rest of the world in steam railroad mileage.

Innumerable other such incidents might be quoted to prove the vast importance of rails to the general problem of transportation. I have gone to such detail because there seems to be a wholly unwarranted belief that railed roads have been, or are in the course of being, superseded by motor trucks and aeroplanes as the most economical methods of transportation. The prepared road bed with steel rails is still the most economical factor in transportation and its introduction marked as great a change as in former millennia the wheeled vehicle drawn by domesticated animals had created.

Between the years 1769 and 1830 lies the first heroic age

of steam driven vehicles. Only 61 years separate Cugnot's steam tug and George Stephenson's complete modern railroad.

This short period of time is crowded with many brilliant inventions, partially known, and many which have escaped attention and which may never come to light. In so brief a space of time, there must be some sequence of ideas could we but trace it. It cannot be an unconnected story, except in the incomplete nature of our data. George Stephenson himself put the matter with clarity and modesty, when, at the height of his fame, he said: "The steam locomotive was not the invention of any one man, but of a nation of mechanical engineers." It came from the brains and hands of the same kind, of practical and persistent mechanics who, within the last generation or so, have produced the modern motor car. Stephenson would have been the last man to deny credit to William Murdock's last model of 1789, or to Walter Hancock and the other builders of common road steam vehicles.

Of Trevithick's steam locomotives, running on rails in London in the year 1803 or 1804, there is no doubt, since we have the word of Sir Humphry Davy, who rode in the "Road Dragon"; George Stephenson may have borrowed the idea of forced draught from this very machine.

There is no question of Blenkinsop's locomotive of 1811 nor any valid reason to deny him a place in the Hall of Mechanical Fame. We have a clear description of his invention. It used Trevithick's device for draught, had two cylinders instead of a single one, notched drawing wheels to mesh with notched rails in order to insure traction. It weighed five tons, consumed 63 pounds of coal and 50 gallons of water per hour and drew 27 wagons of coal weighing 94 tons, at the rate of three and one-half miles

an hour on level tracks, and 15 tons up a slight grade. With a lighter load it could go 10 miles an hour. It did the work of 16 horses and cost 400£. It remained in continuous service for twenty years dragging coal out of mines. It was a mechanical fact, not a myth.

In the year 1812, due in part to his own merits, but, perhaps, more to the death, by accident, of "Old Man Cree," Stephenson became the engineer at High Pit Colliery at a salary of 100 pounds a year. He was a rising man and his words had weight with his directors. He induced them to buy a model of Blenkinsop's engine. Then he did what apparently for years he had been doing to engines. He took it apart and made modifications. He knew that smooth wheels had sufficient traction power, so off came the slower notched wheels. He turned Trevithick's device to get rid of excess steam into a forced draught so he could use coke and charcoal, and made other minor changes, the sum total of which was a better machine. Later, he said: "The first locomotive that I made" (he did not say "invent"), "was at Killingworth Colliery and with Lord Ravensworth's money. I said to friends there was no limit to the speed of such an engine."

There seems no reason to doubt that Stephenson was now ready for his great task. He knew the part the locomotive was to play: he was a steam, not a horse or stationary engine man. Later his son spoke of his studies of railways, of rails and of grades. He had in his mind at least the idea of the proper relationship between all these factors, including locomotives. He had conceived the idea of the modern railroad which was to create the greatest change in transportation since some unknown genius in the Neolithic Age had cast a yoke over the burly shoulders

of a patient ox, harnessed him to a two-wheeled cart and started drawing wealth along earth's early roads.

George was ready. In that ingenious brain lay the thought and the vision; in that stout heart, so often tried, but never failing, the courage to save the world from many a pressing burden. But his age was by no means ready for him.

The date "1815," even today, when the whole world is knit together by the pattern of rails, brings to mind not Stephenson, but Waterloo. Wellington and Napoleon, curiously enough, were born in 1769, the same year in which Watt took out his first patent for an improved steam engine, and Arkwright his first patent for a power driven machine to spin cotton, and Cugnot's steam tug had made those two short but memorable trips through the streets of Paris. In time, Napoleon became Emperor of France, and in the year when Stephenson became engineer at High Pit, Napoleon had marched in Russia's snows into burning Moscow and so to the Island of Elba while Europe took a long breath. But, in 1815 (the year in which Stephenson made his first engine), back came the Corsican for that famous Hundred Days, which ended in a long June day's fighting at Waterloo when Wellington stood stoutly enough behind his British squares praying for night or General Blücher and his Prussians. It was (so all accounts agree), a great victory but a very close affair. Just what it proved, no one can now clearly determine; but the direct result was that a rather weary, and somewhat obese soldier, and former emperor was retired, abruptly, to a tiny speck of an island in the South Atlantic, called St. Helena, where once the Portuguese galleons had stopped on their prosperous journeys to and from India.

This great battle was fought, won, and lost, with flint lock muskets, and the flints which won the war were made at Brandon, England, where flints had been mined since Neolithic times. These flints were essential munitions; hence, they rose and rose in price until it took two English pounds to buy a thousand; and, since a skilled knapper could produce 3,000 gun flints a day, he could earn six pounds a day, or thirty-six pounds per week, while Stephenson was earning two pounds a week. Contemporaneous judgments of values often stand in need of later historic adjustments.

The war, however, did one good thing. It raised the price of horses and horse fodder and thus inclined business men to think about steam and rails, and, in this way, smoothed the path for the first great modern railroad builder.

In the end, and, while her ways are queer, My Lady Destiny has her way—when she wants it.

The great love affairs of Lady Destiny, nèe Necessity, are of absorbing interest to all men; not so her occasional flirtations. This is another way of saying that "Invention" is composed of an infinite number of inventions, seemingly unrelated, but ultimately falling into a coherent pattern which all men may see, measure and admire. There is a glory which beats upon each goal achieved which casts into dark shadows the slow hesitating steps along the trails leading to new plateaus of technical achievement. Yet those also served who only stood and waited, keeping oil in the lamps. Invention, mechanical or social, is at best a tedious and almost invisible process. A more acute apprehension and more careful weighing of data (most of them, alas, lost or at least hidden), might place a higher value on the work of the forgotten men and

their merged ideas. But the world loves her few successes, and of such a one I now propose to write.

Yet for moral reflection, there is a small space. There was, as we know, a time when man bore his own burdens and dragged his own weights. Then came an instant of time between this long and weary era and the first harnessed ox, dragging a sled, and the first tamed horse and wheeled cart. There is a sequence between the marked game trails, the made road, and the stone paved highway. There is, also, a later and more coherent sequence between tramways and railroads, between steam-common-road-carriages and locomotives running on railed tramways. At the end of this last complex of many ideas, there lies the conception, and the fact, of the modern railroad —man's greatest achievement in land transportation in terms of space and time. To this fact many men contributed but one man achieved.

Of all sights visible to the eyes of men in England, in the last decade of the 18th, and the early part of the 19th centuries, that of a bare-footed boy driving cows, chickens and children, off the right-of-way of a coal tramway, must have seemed the least important and the most commonplace; and a coal-pit-road, in Newcastle-on-Tyne, the least inspiring of dramatic backgrounds. One of these boys however chanced to be George Stephenson who had a tryst with Destiny, and who was preparing himself for this future but then unsuspected adventure. For his modest, yet essential services, he received two-pence a day, not, of course, from the coal company, but from the "Widow Ainslie" who owned the cows. Destiny is by no means snobbish in her choices.

George was there to prove the reverse of the optimistic proverb and to establish the sober fact that there is "al-

ways room at the bottom." He was just one more unregarded human cog in that chaotic, yet intricate, system which drew coal from the dark and slimy tunnels of the labored earth and helped it along to satisfy the rising and pressing need of England for fuel and power. He was one of those gnomes who served the Lords of the Black Gold. There was no fox cub in all broad England who did not receive greater care from society at large than he or such as he. At that time there was not in England, or in all the world, perhaps a life so precious as his.

A part of this coal tramway had once been a Roman Road where the Legions had marched when Britain was the most western province. Here the coal carts made a little better going at all times, but more especially in wet weather. If this fact escaped the attention of this bright eyed boy, it is the only fact pertinent to road beds, grades or transportation which is known to have eluded him in the next generation.

Stephenson belonged to the "lower class of mechanics," "the ignorant masses," "the swinish herd," "the ragged rascals"; these phrases, thank God, are not mine; they have been culled from the elegant literature of that period in which he was born and reared, strove and succeeded. He was the son of a common laborer, born in Scotland, who had once been in better circumstances, as the servant of a nobleman who had met financial reverses. A brief description of the family has been left us by a fellow drudge who had known them in other days:

"Geordie and his 'fayther war' like a pair of deals (boards) nailed together and a bit of flesh on the inside; he 'war' as queer as Dick's hat band—went twice around and wouldn't tie. His wife, Mabel, 'war' a delicate bodie and very flighty. They 'war' an honest family but sair

hadden down in the world." The 'fayther' never received more than 12 shillings a week and none of his six children ever went to school.

George did odd jobs on local farms; became a "corftbitter" or slag picker, at the pit-mouth; by the age of fifteen, his father's assistant, and at eighteen a full fledged fireman or pit-engineer earning twelve shillings each week. This was "good pay": weavers at about this time received five shillings a week with very uncertain employment.

At this time he could neither read nor write. At his own expense (of three pence a week), and on his own time, which was, of course, at night, he took lessons from a Mr. Robins Cowens in these mysteries and learned to read and to write in a year's time. In the year 1797 we find him taking lessons in mathematics from a worthy Mr. Andrew Cowens on the same condition. George had come to suspect that some information about "engines" might lie in books: if so, he proposed to have it out.

The English Better People in the early 19th Century did not propose to pamper the lower classes. Illiteracy and long hours and low wages were the bulwarks of British liberties. The Channel's winds were filled with vagrant thought currents from revolutionary France from which the workers must be "protected."

In 1801 we find Stephenson in charge of a steam engine drawing "cowries" or hazel rod baskets containing coal out of the mines or lowering workmen into the mines—in either instance, a matter of responsibility. For this he earned one pound a week.

To supplement his earnings and to supply funds needed for the education of his son, and for his own experiments, he learned tailoring and shoe making. Out of obscurity

a certain William Coe floats down to us in the currents of history, because in 1856 (eleven years after the Rail Master went to his reward) he remembered having bought a pair of shoes from Stephenson for seven shillings and six pence and that "they 'war' good shoes." He also tinkered with clocks and "collected" gold coins which he sold to the Jews for silver at the rate of twenty-six silver shillings for a golden sovereign. He also lent out small sums to fellow workmen at interest.

If his academic education, his book learning, was somewhat meager, his technical and mechanical instruction was of the best. He studied under the finest faculty then on earth: himself; and in the best laboratory: the engine sheds at the mine pits. It is recorded that at night he took the engines apart and cleaned them, learned their faults and virtues, and dreamed of their future. Much of the later history of rails and locomotives was written in invisible but indelible characters on his memory in these nightly sessions in the murky engine sheds when the mines were still. He had an infinite capacity for work and observation and had no self pity.

In 1808, with two kindred souls, he contracted to run three pit engines and keep them in repair. For this he received twenty shillings a week. In 1810 there is a record of a bonus of ten pounds paid for the repair of an ancient Newcomen steam pump and the clearing of High Pit Colliery of water.

Then came the (above referred to) incident of the Blenkinsop engine, and, by 1815, George was ready for Destiny. The casual way in which Destiny set the scene for the meeting of Necessity, Opportunity and Genius, should fill us with admiration.

In the year 1808 a group of Manchester Quakers had

been most properly scandalized at the cost of the transportation of coal by wagon along the public highway between Stockton and Darlington. They appealed to Parliament for a Charter to build a canal. Two years later, they amended this Charter so as to include a proposed railway for horse drawn vehicles.

Wars on the Continent and fears in England, delayed for years the building of either the canal or the railway. But in 1819 the problem was revived under the able leadership of Edward Pease. At his residence one afternoon there appeared two roughly dressed men, one of whom spoke in the thick dialect of the North. They wanted to see Mr. Pease. "Who were they?" queried the doubtful servant. "Just an engine-wright from Killingsworth—that's what he 'war'—just an engine-wright."

Pease saw, listened, and was much impressed by what this engine-wright had to say on the subject of graded rights-of-way, but was a little alarmed at some observations dropped about steam locomotives. At this time Stephenson had been successfully and profitably operating a steam locomotive for four years. But Pease had doubts and regarded it as a dangerous innovation. The doubter was invited to come and see for himself: he returned more and more impressed by the sound common sense of the man, but still doubtful about locomotives, and wrote Stephenson offering him a contract to build the road. Here a grotesque accident almost defeated Destiny. The letter was addressed to "George Stephenson, Esq." No one had ever heard of such a personality. But the postman was diligent, and at last an ancient miner spoke up and said, "Oh, you mean Geordie, the Engine-Wright!" The "esquire" had fooled them: it had been a close thing.

Destiny caught her breath, smiled, smoothed her rum-

pled skirts, arranged her hair, and in all ways prepared for what long Experience had taught her to expect.

The first plan for the railway lay through a rough country where the vixens bred the cubs later to be the principals in the noble affairs of Fox Hunting. The Duke of Cleveland could by no means stomach such an affront even from Parliament at the request of a body of non-fox hunting Quaker coal dealers. A new, shorter, more level and less vixen disturbing right-of-way was laid out by Stephenson. And so in spite of his better nature and high principles, the Duke of Cleveland became a very wealthy man from right of way royalties, and the Stockton and Darlington Railway got started; but not before another interruption. For King George IV, stout Hanoverian, now consented to depart this life in a haze of tardy sanctity and cherry brandy, and much filling and hauling on the Catholic Emancipation Bill, and other serious and disturbing projects then before Parliament. Lady Destiny and "Geordie, the Engine-Wright," and the Quakers, had to await for a decent period of a condition euphoniously referred to as "Court Mourning."

But at last in 1821 the Charter was granted and the matter of building got underway. The project included a railway partially graded, with horses for the level stretches and stationary steam engines for the grades. The idea of a steam locomotive lived only or at least largely in Stephenson's mind, as is proved by a letter written by Edward Pease who regarded himself as the head of the project. The railway was to be open to the public at a cost of four pence per ton mile, but the charge for coal transportation was to be one-half pence per ton mile.

Pease's letters are in part as follows:

"To such a degree have railways been brought that they may be regarded as little inferior to canals. . . ." "The system of cast iron rails is yet in its infancy. It will be found to be an immense improvement on the common roads and also the wooden railway."

All quite correct; to the point, and no nonsense about steam locomotives.

The Stockton and Darlington Railway opened September 27, 1825 and by some means Stephenson had placed upon the rails, together with the horses and stationary engines, a steam locomotive dragging a train of cars and, with his own hand on the throttle, he attained a speed of twelve and one-half miles per hour to all men's amazement! The affair was a success; that is, it made money for the subscribers, and moved coal and merchandise and even passengers with celerity, relative ease, and comfort and great economy. It was now entirely correct to address a letter to "George Stephenson, Esq.," even if the more ancient squires were inclined to sniff and smile at the presumption.

The Northumbrian Hercules was now ready for his next labor and his next task had long been ready for his shoulders.

One of the pressing problems of the time was the great and increasing confusion and congestion in the land traffic between the rapidly rising cotton manufacturing city of Manchester, and the equally rising seaport town of Liverpool. So grotesque had this situation become that it often took longer to move merchandise from Manchester to the holds of the ocean sailing vessels of Liverpool, than to cross the Atlantic Ocean with the goods, and deliver them to the merchants of America. At other times the mills of Manchester were shut down for lack

of American cotton when the wharfs of Liverpool were piled high with bales of this delicate hair seed of destiny. Manchester needed cotton and coal; Liverpool needed freight: the common roads, canals, horses and freight wagons were inadequate. The inventions of Arkwright, of Crompton, of Cartwright and Watt, pressed strongly against an out-worn technique of transportation and George Stephenson was the man to relieve this pressure.

So, in 1824, before the Stockton and Darlington railway was complete, we find him entertaining some quaint notion that there lay in Parliament aid and comfort for a new but already proven idea. The Lady Destiny must have been on a vacation. Greater waste than the energy and time of George Stephenson dealing with "Parliament men" is not recorded in this age of many wastes. They quoted Latin to him, and what they said sounded to him, no doubt, like Greek. They spoke of rock walls sixty feet thick and of bottomless morasses, "chatt moss" of competition with vested interests in canals and wagon routes, of sealing wax and cabbages and kings; they deafened and saddened him, with endless un-wisdom out of books; help lay not in them. They could not break that stout heart, but at least they did their best, and the plethora of their learned words must have wrung like bells of doom in his ears for months, which seemed, to him, like ages.

The merchants of Liverpool and the manufacturers of Manchester were not unfamiliar with mechanical miracles. To these Stephenson turned and not without success. They were willing, more than willing, to go as far as Stockton and Darlington; a little further. They were reconciled to a few steam locomotives, enough at least to prove that they were progressive as well as practical men. But they ardently desired horses and stationary en-

gines, as well, and did not relish spending good money in building viaducts and cutting down hills or spanning swamps. But here Stephenson stood as firmly, or rather more firmly, than those very rocks. The road bed must be as level as man could make it. The day of grades had passed. Stephenson had grown from experience to experiment, from experiments to conviction. He wanted steam locomotives, not as additional power, but as the sole source of power. He kept his tight lipped council, money was placed at his disposal, and, on a December day in 1826, shovels were at work on the first obstacle and the matter was underway. When the question of locomotives came up, he induced his directors to offer a prize for the best locomotive, which, in 1829, he won with his famous "Rocket."

The Stephenson era and the birth of modern railways falls between the years 1815, when he remade the Blenkinsop engine, and the 15th of September, 1830, when the Liverpool and Manchester line was opened, not without fitting ceremonies.

This was a troubled fifteen years for England, one of the darkest she has ever known. The wars in France had ended with victory but the war prices had collapsed! Copper had fallen from 180 pounds to 80 pounds per ton; iron from 20 pounds to 8 pounds, and other things in like proportion. England had lent 100,000,000 pounds a year to her allies and her allies had bought goods from England with this borrowed money. England had not only a war surplus of merchandise and raw materials but also bursting warehouses of consumer goods she had hoped to sell in world markets when peace should return. Now her customers were bankrupt and she could no longer lend them money to buy on credit. The war had

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indeed been her best customer, as Robert Owen had predicted. Moreover, 500,000 former "heroes," who had saved the world from French tyranny and "Democracy" had been changed, as if by sorcery, into a half million angry men clamoring for jobs which did not exist; for the chance to work in positions already occupied by women, children, infants and machines. It was a period of bitter and futile social unrest; a time of want, misunderstanding and terror. There were savage riots and more savage repressions; bad laws and disobedience, and there were also gallant reformers, Francis Place, Lord Ashley, Robert Owen, Wilberforce and Howard and others—brave voices crying in a vast wilderness; saviors not a few. There was talk of the nationalization of land, repeal of laws against combinations; industrial Utopias, prison and ballot reforms; emancipation of Negro slaves in distant colonies but not of industrial slaves who spoke English in mills and factories of Yorkshire; of child labor, of the 10 hour day, of "New Poor Laws" and the passage of "Corn Laws" to save farmers and rents, but to starve cities and lower wages by increasing the cost of food.

The many parallels between 1815 and 1830, and 1918 and 1933 should not escape the attention of thoughtful men.

This was Stephenson's background: this was the environment in which he wrought his miracles.

In 1888 Charles Francis Adams in "Railroads" quoted certain letters of Miss Frances Kemble, daughter of the celebrated John Kemble, and a lady of lively apprehension and facile pen. Stationed in Liverpool at the time, she knew George Stephenson, the man, not the myth. She rode beside Stephenson on a trial trip before the great day; he talked to her of the nature of locomotives,

of viaducts, of stone cuts, of swamps crossed on beds of basket work filled with clay, the Chatt Moss which had terrified the Parliament men: he expressed his opinion of these same Parliament men. To a friend she described Stephenson in the following terms:

"He is a man fifty to fifty-five years old; his face is fine, though careworn and bears an expression of deep thoughtfulness; his mode of explaining his ideas is peculiar and very original, striking and forcible; and although his accent indicates strongly his North Country birth, his language has not the slightest touch of vulgarity or coarseness."

A contemporary description of the opening of the Railroad may be of interest. The main topic was not the railroad, not Stephenson's tunnels, bridges, viaducts or locomotives, etc., but the proposed coming of the Duke of Wellington, premier of England and grizzled, stiff veteran of Waterloo. And, come down, he did, on September 15, 1830, to the town of Liverpool and was visible for a season to lesser creatures. A cannon was fired and the band played "Hail, The Conquering Hero Comes": there were other bands and some regiments, hotel rooms were crowded; there was an elegant car for the Duke and the nobility, including the Earl and Marchioness of Salisbury and Lord and Lady Wilton and a smattering of gentry. The directors rode in a somewhat less elegant car, but right next to the Duke's car. A certain Mr. Huskisson, in his eagerness to shake the Duke of Wellington by the hand, got himself in the way of a locomotive and, as in later ages, lost the decision. He sadly upset the arrangements. Stephenson, putting aside his own affairs got a locomotive, turned it about, and rushed the unfortunate man to medical aid at the rate of thirty-five miles an

hour, faster than ever man had travelled before. This accident, for some strange reason, seems to have a cast a gloom over the company, which even the presence of the nobility and the Duke could not dispel. The Duke decided to return to Liverpool, but the Borough Reeve of Manchester urged him to go on to Manchester or the waiting crowds would riot. Amidst cheers and baby blessings, and hand shakings, the company arrived. But there were also hisses and hoots, and the Duke was pushed and hustled and even pelted with clods by rough men of the mechanical lower classes who were out of work. There were cries of "vote with ballots," "no corn laws," and other distressing, and (according to the papers) un-English cries. The Duke was stanch but was probably in greater danger in Manchester than at Waterloo.

At last, after much excitement, many marvels, and great fatigue, and annoyances beyond reckoning, the Great Affair came to an end. The Manchester mobs had howled their fill; the Duke had been seen, a great cold collation had been duly eaten in a Manchester warehouse, the Liverpool contingent gotten home along the rails by night, aided by signal fires of tarry rope ends. The shareholders found their securities were worth double, perhaps even more. Eight or nine locomotives had been used and over 800,000 pounds invested in rails, rights-of-way, locomotives, etc.

No specific original invention can be traced entirely to Stephenson. Even the authorship of the Miners' Safety Lamp is contested by Davy. But every mechanism which ever came into his hands was improved, every idea he absorbed and modified was placed in its proper relationship to other inventions and ideas. His invention was the synthesis of all inventions dealing with tramways, rails,

grades and steam locomotives. He did not belong to an era: he was an Era.

After 1830, the business men and financiers took up railroad building. They always build up the "country" when money is to be made. There is a fine distinction between making useful things and making money from useful things. Let us examine the condition of railroads eighteen years after the opening of the Liverpool and Manchester line.

The United Kingdom, in the year 1843, had built 2,000 miles of railroads. Between 1848–49 this had increased to 6,000 miles, and between 1850–55 to 8,200 miles. In the meantime, the United States had built 24,000 miles, France 3,000 miles, and Germany 7,600 miles. Thomas Tooke makes the following observation: "The construction of these 40,000 miles of railways in Europe and America has in a great measure obliterated most of the former modes of estimating the time and distance. Every mile of iron road that has been laid down has connected a new or old field of supply with a wider circle of consumers; and it has removed or diminished discrepancies of price and inequalities of distribution. Aided by the facilities of the electric telegraph, extensive states have acquired, for purposes of commerce, the concentration of a single city—."

The effects upon employment in England of this new industry, the Railroad, are matters of interest. Neither technological employment nor unemployment are new social-economic phenomena.

In the year 1848, 188,000 persons, or about 60 per mile, were employed on the construction of 2,960 miles of new railroads, and about 50,000, or 12 per mile, employed upon roads already open for traffic. In 1855, 38,000 per-

sons were employed on 880 miles of new railroad, or about 40 persons per mile; but 95,000 persons were employed, or 12 per mile, on roads open for use.

The difference in employment during these seven years in both construction and operation being somewhat in excess of 100,000 less at the end than at the beginning.

The change in selling prices of railway securities between 1846–1852 may be of some interest.

	1846	*1852*
London & N. W.	215 pounds	118 pounds
Great Western	195 "	86 "
South Western	150 "	87 "
Midland	150 "	57 "
Brighton	135 "	95 "
South Eastern	120 "	64 "
York & N. Midland	210 "	44 "

But whatever may have been the loss to individual speculative investors in the quarter century between 1830 and 1855, England, alone, had acquired over 8,000 miles of the best, cheapest and swiftest type of transportation the world had ever known. And the rest of the world had acquired more than 30,000 miles of the same kind of transportation.

In 1878, Albert S. Bolles estimated that the United States, with a population of 45,000,000, had 79,000 miles of railroads as opposed to 88,000 miles in Europe with a population of 300,000,000 and 11,000 miles of railroads in the rest of the world with a population of over 1,000,000,000 human souls.

Recent statistics later to be given are even more amazing. All that I am now contending is that great inventions

vastly increase world wealth even if politicians and business men largely disarrange its equitable distribution; or, to put it in another way, social invention and imagination always lag behind mechanical achievements. For this the inventors are not to blame.

CHAPTER XXI

TRANSPORTATION IN THE UNITED STATES

THE problems of transportation in the Old and the New World, while dealing with the same general mechanical devices, were vastly different in social and economic matters and diverged in technological details. Back of railroads and steam boats in Europe lay more than 1,500 years of road and canal building and the improvement of wagons and the breeding of cattle. The English mechanical inventions of the 18th and 19th centuries were merely added to an existing and already complicated complex of European transportation. Steam power and rails intensified rather than altered the social-economic backgrounds in Europe.

The United States, in fact all North and South America, started from a most rudimentary stage of transportation. In the absence of any draught animal, save the llama in Peru, and the dog in the North, and the total absence of wheeled vehicles, these two continents were scarcely in the early Neolithic Age in respect to this vital essential of civilization. The history of transportation in the New World, from the 16th Century on, includes every principle device from burdens born by men to the most modern machine and method.

In England and Europe, the new inventions, particularly the railroads, increased the wealth and population of towns already long in existence. In the United States, these same factors, with emphasis upon the steam rail-

roads and steam river boats, built up an entirely new social and economic horizon. These facts must be given due consideration in any later comparison of statistics. It is always easier to introduce new ideas against natural as opposed to social obstacles.

Before the 16th Century, outside of Peru and Yucatan, there were, properly speaking, no roads, only game trails followed by men in seasonable migrations, the same kind of trails left by the hunters of the late Paleolithic ages in Europe and Asia. There were paved roads, viaducts and bridges for trade and military purposes in both Yucatan and Peru before the conquests—better roads than Europe knew at the time, with the exception of the Roman highways.

The first European-built road in America was the narrow paved highway across the Isthmus of Panama connecting the treasure ships of Peru with Spanish galleons in the port of Nombre de Dios from whence this loot sailed for the home ports of Spain.

Crude roads were built in the 17th Century connecting the towns in the separate colonies, and, later, between the colonies themselves. By 1802 there was a continuous stage coach highway connecting Boston, New York City, Philadelphia and Savannah, Georgia. The trip took about twenty-one days at the rate of fifty-three miles per day, "God willing, and weather permitting." These roads were perilous affairs, among the worst roads then known in the civilized world.

In 1792 the first Macadam road was built in the United States, between Lancaster, Pennsylvania, and Philadelphia.

The lack of any means of transportation between the vast territories west of the Allegheny Mountains and

the eastern seaboard almost lost these rich regions to the United States. From time to time, Spain or France would close the *Mississippi* to the corn and wheat, furs and lumber of this region. The eastern seaboard, anxious to trade with the French and Spanish Islands in the Caribbean, was largely indifferent to this danger.

George Washington, who knew this western country, clearly saw the danger and wrote to the Legislature of Virginia suggesting that a road be built to those regions to act as an outlet for its produce. He said: "The western settlers stand, as it were, upon a pivot. The touch of a feather would turn them any way." But the State of Virginia had no idea of spending the taxes of her planters to create competition for these same planters by facilitating the movement of western crops. She stood upon her right as a State to ruin a nation. In 1806, the Federal Government rose to the emergency and began the Cumberland Highway to Ohio. This road began on Braddock Military Road, in Pennsylvania, and was gradually extended to Columbus, Ohio.

It was not until 1850, long after the railroads were rapidly growing in the East and South, that wagon roads or trails were built from east to west. The Oregon Trail, the California Road, the Mormon, Santa Fe and Spanish Trails were all completed in this same year. In technique these roads had little to distinguish them from the ancient roads which led the Neolithic migrations out of Central Asia into Modern Europe. The horse and ox and wheeled vehicles had been improved in essential details but unaltered in principle.

Mr. Washington was a sound, practical and conservative man. If he had ever heard of "fiery chariots," he held them in light esteem. But he was interested in canals, and

one canal in particular was very close to his heart, the Potomac, Monongahela and Ohio Canal. In the year 1785, he was visited by Mr. Elkanah Watson, who modestly admitted himself to be the real parent of the Erie Canal, and, who, in 1820, in the city of Albany, New York, published his notable, but largely unread, *History of the Rise, Progress, etc., of Western Canals*. Here are his own words: "In the winter of 1785, I spent two days with the immortal Washington at Mt. Vernon. His mind being intently settled on the project of connecting the western waters with his favorite *Potomac* and improving the navigation of the *Monongahela* and other branches of the *Ohio*, principally with the view of diverting the fur trade from Detroit to Alexandria, Virginia, instead of going to Montreal, as heretofore."

Mr. Watson copied these notes and proceeded to use them to stimulate the construction of the rival Erie Canal. The fact that Washington held some property in and around Alexandria proved only that he was a practical as well as a great man.

There are several letters from Jefferson to Washington encouraging the building of the latter's favorite canal. And, in 1817, Jefferson wrote to Von Humboldt as follows: "The most gigantic undertaking yet proposed is that of New York for drawing the waters of Lake Erie into the Hudson. The expense will be great, but its effect incalculably powerful in favor of the Atlantic States."

Jefferson was right. The Erie Canal was opened in 1825. By 1830 freight rates between western New York and New York City had been reduced 90%. A million dollars a year was collected in toll rates and the value of farm lands along the Canal had more than doubled in price.

After the United States had consummated the Louisiana Purchase her next great problem was a steamboat capable of forcing its way up river. Fulton had, in 1807, established river navigation on that tranquil tide-estuary, the *Hudson* River, with the aid of a British-built engine. And by 1812 steam boats were on the Mid Western rivers. But these rivers flowed one way, down stream, and at seasons of flood rather vigorously in that direction. Country produce could get to New Orleans and be loaded into the holds of ocean sailing vessels; but manufactured goods could not be returned in exchange except at a prohibitive freightage cost. Tea, on the middle western farms, cost $3.00 per pound, or the value of an acre of harvested wheat; woolen, cloth, iron, tools, arms and ammunition, furniture, salt, etc., cost in proportion.

I am not wholly unmindful of the several experiments with steam boats of James Ramsey in 1784 nor of John Fitch in 1786. But these inventions had no effect upon economic and social affairs. John Stevens patented a tubular boiler in the United States in 1791 and 1803 and in England in 1805. To this vigorous genius the screw propeller is also attributed. These are all part of the general records from the mechanical point of view, but they had no immediate effect upon commerce.

In 1812, Fulton built, in Pittsburgh, the *New Orleans* at a cost of $40,000. This vessel combined steam and sail. In October of that year she made a trip to Louisville, Kentucky, but was wrecked on a snag in the year 1814. In 1813, the *Comet* was built, in Pittsburgh, by D. French, sailed or steamed down to New Orleans where her engine was removed and placed in a cotton mill.

Neither of these boats had solved the up river problem. In 1815, the stern wheeler *Enterprise* was built and made

the up river journey from New Orleans to Cincinnati in twenty-eight days. Such boats still ply the waters of the *Mississippi,* the *Ohio,* the *Red* and the *Missouri* rivers. One of the later types reposes in great honor in the river Henry Ford built in his museum village at Greenfield, Michigan. Its name is *"Swanee River"* and it still can get up steam and chug along with the great motor builder at the helm. It is not much of a boat to look at, but it solved the navigation problem for all the one way rivers in the world.

Wells gives a traffic chart for steam boat travel to New Orleans between 1815–1860, less than half a century. I have selected the first and the last years for purposes of comparison.

In the year 1815, 40 steam vessels arrived in New Orleans with 77,220 tons of freight valued at $19,044,640. In 1860, there steamed into this same port 3,566 vessels, carrying 2,187,560 tons of freight, valued at $185,211,154. This was a notable achievement, a mechanical triumph over natural difficulties in the interest of economic and social advancement. It has all the indications of a secondary American invention. Fulton, and, indeed, all the early steam inventors of the United States, except perhaps Fitch, drew largely upon British invention and British technology. But these original inventions had to be modified to suit the peculiar nature of America's physical conditions.

While these matters were taking place on southern and middle western rivers, the North, inspired by Fulton and the rapid completion of the Erie Canal, was by no means inactive. In 1818, the first steamboat was built for the trade on the Great Lakes, then beginning to be considerable. (The Erie Canal was finished in 1825). It was *The*

Walk In The Water, named after a celebrated Indian Chief in Michigan. She was built in Black Rock, New York, on the *Niagara* River, her engines being brought up from New York City by sloops to Albany, and thence dispatched by six and eight horse teams overland to the *Niagara* River. The different parts of the engine arrived from Albany in fifteen to twenty-five days' time. *The Walk In The Water* was brig-rigged and of 360 tons burden. Being lost in a gale in 1821, she was replaced by *The Superior.* As trade on the lakes increased, more steamers were put into business by other people at all the large ports.

A decision of Chief Justice John Marshall of the Supreme Court of the United States in 1815 is a part of the record of river steam boating in the United States. Fulton had a monopoly of steam navigation on the *Hudson* River and in the harbor, granted by the State of New York. But the Federal Constitution claimed control of all navigable rivers. Colonel John Stevens attacked Fulton's monopoly and Marshall's decision was as follows:

"The power to regulate commerce does not look to the principle by which boats are moved. That power is left to individual discretion. The act demonstrates the opinion that steam boats may be in common with vessels having sails. They are, of course, entitled to the same privilege and can no more be restrained from navigating the waters or entering ports than if they were wafted on their voyage by the winds instead of being propelled by the agency of fire."

I interpolate, somewhat out of sequence, and by way of contrast, another American invention often more largely commented on—the steamship *Savannah*—the

first vessel propelled (at least in part) by steam to cross the Atlantic Ocean.

In the *London Times* of June 30, 1819, appeared this notice: "the *Savannah,* a steam vessel, recently arrived at Liverpool from America, the first vessel of the kind which ever crossed the Atlantic; she was chased the whole day off the coast of Ireland by the *Kite,* revenue cutter, which mistook her for a ship on fire."

The entire matter leaves many doubts in the mind. On her trip across the Atlantic, the *Savannah* was under steam fourteen days and under sail eight days. She entered Liverpool with sails furled and smoking vigorously. She then sailed to Sweden where the King offered to buy her for $100,000 in hemp and iron. But she had not made the venture for "country pay." Home again she made her somewhat dubious way, removed her engine and returned to the ways of sail for which she had originally been built. A few years later, she was wrecked off the coast of Long Island. Her owners lost $50,000. She has somewhat the savor of a speculative venture. Of her Bolles says: "The trouble with the *Savannah* was that her engines were imperfect. They consumed too much coal and there was no room for cargo. It was about twenty years before the steam engine was developed sufficiently to make ocean steam navigation profitable and when that time arrived the English were the first to take advantage of it."

The year 1869 was notable in the history of world transportation. Ever since Vasco da Gama's memorable voyage in the last of the 15th Century, the water route to India for western Europe had been around Cape of Good Hope. But there were two other land ways; one by caravan across Asia, to the Caspian Sea and the other from

the Persian Gulf or the Indian Ocean to the Red Sea and across the desert to the *Nile* and so into the Mediterranean. All of these ways were long, hard, dangerous and expensive, and open to all manner and degrees of tribute and political interference.

Then, in a single year, the Suez Canal was opened, cutting off 5,000 miles of storm or calm-infested ocean, and reducing the time from seven or eight months to one hundred and twenty days. In the same year, 1869, the first transcontinental railroad across the United States was completed and combined with steam vessels on the Pacific and the Atlantic. This reduced the time from the Far East to London to forty days, or two-thirds of the time by the Suez Canal. This brings the transportation problems of the United States into the world transportation complex and the story of ocean steam vessels.

For fifty years, steam had been used on rivers, lakes and harbors, but the men of the open sea would have none of the ugly, smoky monster. There was an even greater obstacle: The engines and fuel took up too much space. There was no room for cargo and passengers.

In 1897, the compound marine engine was adopted which economized the consumption of coal 60%, and, hence, made ocean freights cheaper and left more room for passengers. Steel took the place of iron in hulls and engines, making lighter and stronger and larger vessels possible. The propeller took the place of the paddle-wheel; and, within the last decade, Diesel engines are replacing steam with further economies in space and speed. To-day, on the oceans of the world, there are 30,000 steam vessels of 100-gross tons, or over-burden, or a total of 65,000,000 gross tons steam shipping.

Whether we reckon from the *Charlotte Dundas,* the

Clermont, the *Savannah*, or the Suez Canal, or the compound engine, it remains one of man's most amazing technical achievements.

English engineers may have learned something from the *Savannah*. On the 23rd of April, 1838, two British-built steam vessels, the *Sirius* and the *Great Western*, sailed into New York Harbor. In 1840, the *Royal Mail* (Cunard) followed. An American line to Bremen was started in 1847, the Collins Line to Liverpool in 1850, and the Garrison Line to Brazil in 1865, all from New York. The Pacific Mail Line to China started in 1865.

"When 1865 came, however," says Bolles with regret, "England had 125 steamers running to the United States and had virtually monopolized the steamship traffic. . . . The only line we (the United States) have to Europe today (1879) is that of the American Company of Philadelphia which employs four 3,000-ton steamers in the trade."

Swift and stout as were the great sailing ships, they were but the sport of adverse winds. In England a whole galaxy of new machines had created a demand for new markets. The Napoleonic wars and the revolution of industrial processes had stepped up the tempo of life. Men decided to try steam on the journey around the Cape of Good Hope. The voyage of from five to eight months between Portsmouth and Calcutta was too long.

In the *Oriental Herald*, of Calcutta, of March, 1825, appears this optimistic notice: "We are at length enabled to announce the certainty of a steam vessel sailing for India by way of the Cape of Good Hope. . . . In the way now chosen there are no obstacles but a supply of fuel at intermediate stations and the weathering of heavy gales off the Cape."

Aided by 200,000 pounds of English money, and an offer of a prize of 1,000,000 rupees in India for a successful steam voyage within a time limit, a naval officer, James Henry Johnson, decided to make the attempt. The glowing prospectus of the company announced: "Calculations hold out every prospect of her reaching Calcutta within two months of her leaving Portsmouth."

Built accordingly, the ship was perhaps too hurriedly constructed and launched without the necessary trial trips. She was well named the *Enterprise,* and, on August 16, 1825, her paddle-wheels turned around and she left Portsmouth on her desperate venture. One hundred and three days later she chugged into Calcutta Harbor too late to win the offered prize, too slow, too much use of sail, etc. No fair-minded man could call such a voyage a failure, except in the money sense. The truth was that the steam engine was not yet ready for ocean navigation. The *Enterprise,* however, with her stout-hearted Captain, stayed on in the East and did good service in the Burmese War and in an effort to cut down time between India and England by steam navigation in the Red Sea, a trip across the sands of Egypt, and a reshipment by steam vessels through the Mediterranean Sea and the Bay of Biscay to England. This latter venture also failed because of the usual stupidity of men known as politicians and diplomats.

As usual, the world had to wait for the unusual man. In this case it was Ferdinand de Lesseps, destined to build the Suez Canal and also destined to have a lot of trouble, not with the African sands, but with the selfishness of men.

Five thousand years before, the Pharaohs had dug canals between the *Nile* and the Red Sea, that their

shallow-draft, square-sailed argosies might venture to the Land of Punt for storax, gum and myrrh, for gold dust, ivory and black slaves, to the end that in life and in death the rulers of the *Nile* might not be lacking in elegance.

In 1799, Napoleon glanced with an intelligent interest upon this neck of sand separating two worlds. He sent his engineers to look into the matter. But the Arabs objected in their usual manner. Neither camels nor horses needed canals. Engineers cannot look fruitfully through instruments, with the requisite calmness, while being shot at and cut at by ambushed Arabs. So Napoleon's engineers returned and made a report that the Red Sea was 36′ higher than the Mediterranean and that, hence, the canal was impossible. This error kept those sands inviolate for a half century. DeLesseps took another view of the matter and learned the truth. He knew Egypt and Egyptians, had been, in fact, the boyhood companion of Said Pacha who, through the grace of Allah, in the year 1854, did become the ruler of Egypt and viceroy to the Sublime Porte in Constantinople. On November 15th of this same year, de Lesseps executed a 99-year lease for the land to build the canal. The Egyptian Government was to receive 15% of all net profits, 75% was to be paid to the shareholders, and the remaining 10% to founders. The vessels of all nations were to be admitted on an equal basis.

There remained, it would seem, nothing then but to dig up a few acres of sand and the voyage to India could be reduced by five thousand miles of stormy ocean. The sand was the least part of the matter. There followed one of the most sordid examples of English money-diplomacy the world has ever seen. No nation could or did profit more by such a canal than the English. But Palmerston

wrote to de Lesseps, "I must tell you frankly that what we are afraid of losing is our commercial and maritime preeminence, for this canal will put other nations on an equal footing with us." Every slimy trick was tried, war was threatened, propaganda flourished until even the keen mind of de Lesseps must have faced chaos and his stout heart must have faltered.

There seems a peculiarly bitter irony in the fact that the wealthy son of Geordie, the Enginewright, whose dreams had given the world the gift of the steam railroad, should have stood so stubbornly in the way of de Lesseps' dream. But the fact remains that he had in his possession an engineer's contract calling for a fee of 55,000 pounds to build a railroad in Egypt when he was a commissioner to pass on the merits of the canal. So he pronounced the canal impractical because the two seas, the Red and Mediterranean, were on the same level!

Palmerston took one parting shot at the canal in the following words: "It is one of those plans so often brought out to make dupes of English capitalists and leave them poor. The scheme was launched, I believe, fifteen years ago as a rival to the railway from Alexandria by Cairo to Suez, which, being infinitely more practical, and likely to be more useful, obtained preeminence."

But the grain of mustard-seed was with de Lesseps. The canal was financed, dug and open for traffic on November 17, 1869.

But, before the canal was open, Disraeli, aided by the Rothschilds, secretly bought for England (in a good market) $20,000,000 worth of canal securities held by the bankrupt ruler of Egypt.

In the year 1870, 486 vessels passed through the Suez

Canal, 75% of which were of British registry, as was 65% of the gross tonnage.

In 1819, six years before Stephenson completed the Stockton and Darlington Line, the admirable Bolles quotes a London paper as follows: "The Americans have applied the power of steam to supersede that of horses in propelling stage coaches. In the State of Kentucky a stage coach is now established which travels at the rate of twelve miles per hour. It can be stopped instantly and set again in motion with its former velocity: and is so constructed that the passengers sit within two feet of the ground. The velocity depends upon the size of the wheels."

That any such vehicle ever ran on the kind of roads Kentucky had at that date seems to me most unlikely. This was several years before the steam wagons of Walter Hancock and others in England. The earliest mention of steam wagons on roads in England was 1824. Of course, there was Cugnot's experiment in Paris in 1769 and steam locomotives had been used in English coal mines and for exhibition purposes as early as 1804. But the story, to receive full credit, demands a somewhat more robust mechanical patriotism than the writer possesses—or a few more facts.

There is also an account regarding a wagon-boat of Evans, which, in 1794, ran through the streets of Philadelphia, sailed down the river under its own power, and, after this great success, was turned into a power plant for a grist mill. In 1824, a certain S. T. Conn, of Virginia, advertised for capital to form a company to run a steam carriage on the turnpike between Washington and Alexandria. But, in 1825 (the year the Erie Canal opened),

the State of New York appropriated $500,000 to build a great horse railroad from the *Hudson* River to the Great Lakes. Surveys were ordered for such a road. But, in spite of Stevens' prophecy in 1812 about steam locomotives, there is no mention of such innovations in this bill.

America's first railways, as in England, were for horses. In 1826, building began on a line three miles long, leading from marble quarries at Quincy, Massachusetts, to Fore River docks. A line of railways nine miles long was also begun in the year 1828 at Mauch Chunk, Pa., to connect with the Lehigh River and bring anthracite coal to Philadelphia. This track cost from $2,500 to $3,000 per mile and followed an older wagon road. Wooden rails were laid on wooden sleepers, lying four feet apart and fastened by wooden pegs. The sleepers were supported on stone foundations and the rails plated on the outer edges with rolled iron bars from 1¼ inches to 1¾ inches wide. A gravel path for the horses was made between the rails covering the sleepers. The wagons weighed 1,200 to 1,500 pounds and ran downhill for the first five miles, dragging back the empty cars by gravity. Horses were used on the level stretches.

The Delaware and Hudson Canal Company is sometimes, somewhat enthusiastically, referred to as our first steam railway. Perhaps the account of the original engineer may throw some light on the matter.

In the year 1828, Mr. Horatio Allen was sent to England to buy rails and locomotives for this line. In a letter, dated July 19, 1828, to his directors, he wrote that he had purchased one locomotive from Robert Stephenson and Company, of Newcastle, and three others from Foster, Rastrick & Company of Stourbridge.

On April 8, 1829, the famous Stourbridge Lion was duly

shipped from Liverpool on the packet *John Jay* and reached New York City on May 13th of that year. Its cost, delivered, was $2,914.90.

On August 5th, John B. Jervis (for whom Port Jervis, N. Y., is named) wrote: "We have the Lion on the railroad and shall probably put steam on her tomorrow or next day." This must have been a great day. The dawn of a new era! Young America was about to harness the Giant Steam to the conquest of a waiting Empire! The fates were brooding, as it were. This is the kind of enthusiasm which comes of looking backward at events. Here in part are the facts, as written to President Bolton, by this same Mr. Jervis, on August 8, 1829: "This morning we put steam on the Locomotive for the first time, and by giving her motion in this way, brought the entire strain we have to provide for. The result has led us to the conclusion that our curved road with fifteen feet stretches will require additional support. We have not had much trial on straight road, but so far as we had opportunity, there is not apparently any important deficiency in strength—not so much as to induce us to believe there will be any immediate necessity for additional support. I am not able to state the amount of work of this kind that will need additional strength, but the quantity is not great. The engine goes round the curve very well—the difficulty being in the road, as above mentioned. The locomotive will, I think, fully answer our expectations, when we get the road firm enough to bear it. So far, I think, all the difficulties discovered can be easily remedied, though it must necessarily be at some loss of time which is greatly to be regretted, though unavoidable."

The sad truth of the matter was that the American rails were not strong enough to support the British

engine. It was one thing to buy a British locomotive, but, as yet, there was no George Stephenson in the United States to lay the proper roadbed and rails for steam traction power. The Stourbridge Lion was run a few miles and abandoned.

The History of the Delaware and Hudson Company, 1823–1923, goes on to state: "It has hitherto been the belief that following this trip the locomotive was removed from the tracks and never again used. This was not the case. It was run again on September 9th, 1829, as is shown in a letter from Horatio Allen dated Honesdale, Pa., September 13, which states: 'On Wednesday last, we had the engine in motion again and its operation and effect on the road carefully observed. The railroad, as it now stands, is not sufficiently stable for the operation of the locomotive. Before it is put to work on it, the road ought to be carefully examined and strengthened, without doing so it would be unsafe to put the engine to work.' "

The Stourbridge Lion was put under a rough covering of boards and not until 1849 was it taken to Carbondale where its boiler was used ignominiously in the shop. The three other locomotives were delivered in due season, painfully paid for and stored in a shed at Roundout, New York, where they were later destroyed by fire, never having turned a wheel on an American rail. After all, the Delaware and Hudson was a canal and its purpose to make money by the cheaper transportation of anthracite coal to New York City. The destiny of the great West, of locomotive travel, the conquest of a Continent in no wise concerned the directors. But the failure of the locomotive, or rather the inadequacy of the railroad, depressed the value of their securities in the New York market.

Bolles states: "In South Carolina a company was incorporated December 19, 1827 to build a railway and canal out to Hamburgh on the *Savannah* River in order to open up easy communication with the rich agricultural region lying in that direction, the intervening districts being a wilderness of swamps. United States Army engineers made the surveys, as they did for all these early railways (a splendid idea). The road was originally built upon trestle work nearly the whole distance, with a thin strap rail of iron upon stringers. In 1830 when the road had been finished for only eight miles, several months before the opening of the Liverpool and Manchester Railway in England, upon which steam engines were employed, but, of course, five years after the Stockton and Darlington Railway where locomotives were used in part, at least, an event occurred which created a furor of excitement on both sides of the ocean. A locomotive, weighing five tons and called 'The Best Friend' was operated on this South Carolina Railroad. It had been built at the West Point Foundry in New York City, under the direction of E. L. Miller of Charleston, South Carolina, and was the first one used in passenger and freight business of the United States."

This line of 135 miles has been stated to have been the longest on earth at that time. But there is no further mention of more locomotives and perhaps the old reliable horse was substituted. To attempt to compare this experiment with the Liverpool and Manchester line is of doubtful historic value or validity. We must not forget that horsecars running on rails were a very efficient method of travel as compared to the old common roads. As recently as 1891, Watkins, an expert in the history of

railways and rails, points out that horsecars were cheaper than steam for city and even suburban travel and that they paid handsome dividends.

It is no reflection on Miller's "The Best Friend," nor John Stevens' model engine which ran on a circular track in Hoboken in 1825 (as Trevithick's had in London in 1804), nor Peter Cooper's "Tom Thumb," run on the Baltimore and Ohio in 1830, nor the "DeWitt Clinton," built for the Mohawk and Hudson (the New York Central), to regard them all as experimental reflections of English ideas.

I have come to suspect that some of these earlier American locomotives were "window-dressing" for enriching the financial picture. People with money to invest had heard of English engines. The idea of a locomotive on American rails roused their patriotism and loosened their purse strings.

In 1832, Mr. M. W. Baldwin, of Philadelphia (a name not unknown today in engine building), produced his first engine and named it in honor of the gallant frigate *Old Ironsides*. It was reputed to have attained a speed of thirty miles per hour. Let us compare this statement with a contemporaneous advertisement in a Philadelphia newspaper: "The locomotive-engine (built by Mr. M. W. Baldwin, of this city) will depart daily (when the weather is fair), with a train of passenger cars. On rainy days, horses will be attached." It seems to me that the engine was a kind of curiosity, but the horse was the real power.

Mr. Rush, United States Ambassador to England in 1825 (after the Stockton and Darlington Railway), is reported to have said: "Whatever Parliament may do (about railways in England) they cannot stop the course

of knowledge and improvement. The American Government has possessed itself through its ministers of the improved mode of making and constructing railroads: and there can be no doubt of their immediate adoption through this country."

No doubt whatever. American men of affairs kept a keen eye on English machines. In spite of laws to prevent it, Hargreave's spinning-jenny was known in the United States at least as early as 1775 and Francis Lowell spent a year (1811–1812) in Scotland studying the power loom and came back in 1813 and "invented" the first power loom in America. Friends of Mr. Lowell's, quaintly enough, spoke of it as his loom, disregarding Cartwright's earlier claim in the matter.

The Central Steel Company, of Massillon, Ohio, recently issued an illustrated booklet entitled *Development of the Locomotive.* It is a most welcome and charming addition to the slight material gathered on this vital subject in the United States. One fact it demonstrates: Invention in the United States is not related to original ideas but rather to the adjustment of these ideas to the peculiar problems of steam locomotives and railroading in that country. It was one thing to build the early roads in level, cultivated, England, in the home (then) of the modern iron industry, and in an age of skilled mechanics and abundant and concentrated industries. It was quite another to build railroads and locomotives in a new country where distances were vast, natural obstacles great, where credit was used in place of capital, and where the population was both scant and scattered. The invention of the swiveling truck, credited to John B. Jervis, was first applied to the "George Washington," a stout locomotive, which in 1836 hauled a load of 31,720 pounds up

an inclined plane 2,800 feet long, with a grade of 369 feet, at 15½ miles per hour. George Stephenson would have turned gray at the thought of such a grade. But in the United States, engineers had to take chances. Eventually, this principle was applied to all mountain locomotives. The Mogul type, built in 1863, was founded upon this idea. Transportation in the United States was a different problem from that of Europe. It required a different and somewhat bolder approach to engineering problems. A letter, written to James M. Swank, in 1882, by Francis B. Stevens, illustrates this point of view.

"I have always believed that Robert L. Stevens was the inventor of what is called the 'T' shaped rail, and also the method of fastening it by spikes. And I have never known this right to the invention questioned. The Camden and Amboy Road, laid with this rail, was opened October 9, 1832. The rail, long known as the Camden and Amboy rail, differed, but little, either in shape or proportion from the 'T' rail now in use. For the next six or eight years, it was little used here or abroad. Nearly all the roads built in the United States using the flat iron bar about 2½ inches by ¾ of an inch and the English continuing to use the chain and wedges. . . . My uncle always regretted that he had not patented his invention."

Ashbel Welch, addressing the American Society of Civil Engineers said: "American engineers have often shown that poverty is the master of invention. For example, they used wooden cross ties as a temporary substitute, being too poor to buy stone blocks, and so made good roads because they were not rich enough to make bad ones."

The first rail mill was erected in the United States at Mount Savage, Alleghany County, Maryland, and the

first rail rolled in 1844. It was a V form made on the Bevan English patent. There followed a swarm of new types of rails until the modern standard type was evolved.

In the first report of the Pennsylvania Railroad, 1845, more attention was paid to a canal disaster caused by a flood than to railroading. The directors had prevented the Baltimore and Ohio from seeking a western outlet across the state of Pennsylvania and were willing to pay interest on investment out of stock subscriptions in order to raise $3,000,000 to complete 15 miles of road out of Pittsburgh and Philadelphia and promised in a few years to have a continuous railroad to Pittsburgh with the exception of a 55-mile stage coach ride through the Allegheny Mountains.

It was not until 1850 that the New York Central reached the Great Lakes. The second line opened was from Boston to Ogdensburg, in the same year, and the third, from New York to Erie in 1851. The Pennsylvania was opened in 1852 but the mountain division was not ready until 1854. The Baltimore and Ohio was opened in 1853. By 1850, the Western and Atlantic Road of Georgia reached Tennessee and, by 1859, through Memphis and Charleston to the *Mississippi.* Jennings says: "By 1860 several important connections for the country as a whole had been made. Boston and Albany in 1841; Lake Erie and the Ohio in 1848; New York and Boston in 1849; New York and Lake Erie in 1851; New York and Chicago in 1853; Lake Michigan and Ohio in 1854; Lake Michigan and Mississippi in 1850 and 1854, and the Missouri River in 1859."

Railroads in New York State were impeded by the opposition of the Erie Canal and its legislative friends, and at one time, to all railway freight charges the canal

tolls were added. The Civil War brought road building to a pause in the United States, but, after the war, it was taken up with added energy.

Between 1830 and 1876, the public in the United States had invested $4,087,225,000 in railroads, or about one-quarter of what the United States spent in the last fifteen years on hard-surfaced automobile highways. A large part of this capital was raised in Europe and came to America in the form of railway iron. Between 1840 and 1870, the United States imported from England alone 5,200,000 tons of rails. In 1864 rails cost $154. per ton: 1865, $83. per ton and in 1876, $40. War costs more than appears on the surface.

CHAPTER XXII

THE COMMON ROAD COMES BACK

THE astronomers, who look down upon lesser mortals, inform us that it is only 238,000 miles from the earth to the moon. Men in gas balloons have thus far traversed only about twelve of these miles into the stratosphere. There are more miles of railroads in the United States than it would require to reach the moon. Historians have estimated that the Roman Empire (which made the best roads ever yet built upon this earth) contained between 47,000 and 80,000 miles of hard surfaced roads between the *Thames* and the *Euphrates,* from the *Rhine* to the Sahara. Perhaps earth's longest roads are the caravan routes across Asia and Africa.

Four hundred years ago, outside of a few miles of paved trails in Peru and Yucatan, there were no made roads in the New World. In the year 1932, the United States alone contained 3,000,000 miles of man-made roads, several hundred thousands of which were concrete or hard surfaced.

It is now possible to travel in wheeled vehicles to any part of the United States on roads that permit of a very high rate of speed. Only the modern trunk line roads have been planned for the automobiles and the motor trucks. If you look down from an aeroplane, you can see the tangle of old roads leading from farm to farm or from farm to village. These roads follow the contour of the

country and avoid difficulties. Rivers were first crossed by fords or ferries, before we had bridges. But the new roads and railways cut across this tangled pattern and run straight as the arrow flies to the larger destinations. In New York City, viaducts have been built to avoid local traffic and great parkways lead in and out of the city, lined with gardens and lawns and forests, and dotted with pleasant spots to rest and eat and enjoy nature after the confusion of the incoherent city. All these, the citizens of that city owe to the imagination, training and strong good will of Park Commissioner Robert Moses. He, more than any other man, has clearly seen the social implication of motor travel. No discordant, blatant advertising signs mar the beauty he has created. Even the gasoline stations that border the roads are in severe and simple good taste.

On these three million miles of United States roads, there were in operation (in 1937) 28,000,000 registered automobiles, or an average per mile of road of more than nine internal combustion engines in wheeled vehicles, capable of going at the rate of fifty or more miles per hour. Seventy percent of the world's automobiles are in the United States. It is estimated that all the motor cars in the world today could generate 1,000,000,000 horse-power or fifteen times the amount of power generated by all other forms of engines. It has been estimated that the cost of the cars in the United States, purchased at retail, the charges for gas, oil and tires, maintenance of machines, roads, advertising, taxes, including registration fees, State and Federal taxes on gas and oil and income taxes on profit, amounts to more than $7,000,000,000 per year. To the amazing total of cars, must be added the half million trailers now in use. Over half, perhaps three-

quarters, of this vast outlay is for pleasure rather than for business.

But there is another cost not quite so clearly understood. It is that of the heavy rate of mortality due to the motor cars. In 1922, there were 14,988 deaths from automobile accidents in the United States. In 1935, the Travellers Insurance Company, of Hartford, Connecticut, estimated the deaths of motorists at 36,100, to which must be added 16,030 deaths of pedestrians. There were over 700,000 reported accidents. The nature and causes of these accidents have been recorded with fast and reckless driving as the main cause. The apathy of the motoring public and the indifference to these amazing figures is a strange phenomenon. Compared to the number of miles traveled and the number of motorists, the percentage of casualties may appear small. But the fact remains that more than 50,000 people are killed each year and hundreds of thousands seriously injured. It is a heavy social price to pay for the ability to move over roads at a high rate of speed.

In the United States, there are almost 250,000 miles of railroad and 385,874,136 travel miles per annum. In 1935, over 5,000 persons were killed and 28,000 injured—an appalling number, indeed. Yet the statistics broken down are illuminating: Only 18 passengers were killed and not a single life was lost in a Pullman coach; 600 employees lost their lives; 1,777 non-trespassers and 2,712 trespassers were killed. Many of these deaths were at grade crossings and perhaps should be included with the automobile fatalities. In the year 1937, 116 people lost their lives in aeroplane crashes and from 1912 to May 16, 1937, 384 lives were lost in dirigible disasters.

The early railroads, like the early common roads, were local affairs intended to serve local needs. In the year

1840, five changes had to be made to travel by steam railroad between Albany and Buffalo and between New York and Washington. For a time, and a relatively long time, railroads had such advantages over all other methods of travel that the stimulae to invention and improvement ceased to press upon the financial management. Bankers, not engineers, came into power. This movement has been somewhat arrested. The rails may come into their own again with planning and improvement. There is no reason to question that, with proper roadbeds and rails, laid out with science, much greater speeds are possible. The railroad of the past built up the United States; the railroads of the future will vastly enrich and vastly simplify transportation and civilization. The day of rails is by no means over.

The *World Almanac* for the year 1938 gives certain illuminating facts on the speed of locomotives on rails. In May 1848, the Great Western (England) made a run between London and Didcot, a distance of 53.25 miles, in 47 minutes, or at a rate of 68 miles per hour. Forty-five years later, in May 1893, the New York Central & Hudson River Railroad covered a distance of 1 mile in 32 seconds, or at the rate of 112.5 miles per hour. In April, 1935, the New York, New Haven & Hartford Railroad ran from New Haven to Boston, a distance of 156.8 miles in 2 hours and 23 minutes, or at the rate of 65.78 miles per hour. In October, 1936, the Burlington (C. B. & Q.) ran from Chicago to Denver, a distance of 1,017.23 miles in 12 hours and 12 minutes and 27 seconds, at a rate of 83.3 miles per hour.

In Germany, the Flying Hamburger, a one-car train with a Diesel engine, travels 120 miles, between Berlin and Hamburg, at the rate of 82.158 miles an hour.

On November 16, 1936, a new record for railway speed was set up by a London Midland and Scottish test train which covered the 401½ miles between London and Glasgow in 5 hours, 53 minutes, an average speed of 68.2 miles per hour, or just .2 of a mile faster per hour than the time set by the Great Western in May 1848, or 89 years previously.

The achievements of the United States in the mileage of railroad is one of the most amazing records in the history of transportation. But this nation seems to lag behind in matters of speed, and this can be attributed more to the question of road-beds, grades, etc., than to the mechanical construction of locomotives.

After more than 100 years, George Stephenson's ideas about grades are still of importance. It seems to me that from this record alone, the railroads of the United States should give a little more prominence to their engineers and a little less to their business men.

CHAPTER XXIII

EUROPE CONQUERS THE EAST

No period of European history is better known, more completely documented, or more dramatic, than the Age of Discovery, of ocean trade and world colonization, which begins, according to orthodox historians, in the latter decade of the 15th Century with the memorable voyages of Columbus to the West and of da Gama to the East. For thousands of years, the turbulent Atlantic had been an impassable barrier to the further westward movements of those cultures from which modern Europe evolved. In an incredibly sudden gesture, this barrier is broken, and, for almost a century, Portugal controlled not only the western water routes to the East but the ocean-born trade of the eastern world, while Spain conquered and colonized the New World. The Portuguese adventure is the more remarkable of the two, since it shows a small and weak European power completely dominating the maritime destinies of the Orient where ocean trade and navigation were infinitely more ancient. As the power of Spain and Portugal diminished in Europe, the Dutch, English and French entered into this situation and snatched from Portugal and Spain the major portions of their conquests. But never since da Gama's memorable voyage, down to today, has the control of the maritime East been regained by any Oriental nation. Never has any native Asiatic race even challenged western European control. The sole apparent exception

to this statement is Japan, and, so far as technical matters are concerned, Japan has followed the Occidental, rather than the Oriental, pattern.

Obviously, these phenomena can be explained only on the basis of a technical superiority in certain matters of the West over the East. The inventions mainly responsible for these situations are the western Atlantic ocean-going vessel, the modern navigator's compass, cheaper iron and a more extensive use of iron because of cheapness; the introduction of gunpowder and cannon, and, later, of small arms. It was from first to last the conquest of technology.

Back of the 15th and 16th centuries, lay a long period in which Europe gradually expanded and slowly perfected these inventions.

As early as the 10th Century, the Christian missionaries of Europe began to venture beyond the limits once set by the Roman Empire and to explore the Northern land routes. The conversion of northern Europe by these military missionaries, and the establishment of trade relationships with these pagan nations was a part of this movement of exploration. The piratical adventures of the Vikings, which had so profound an influence on the history of France and England, the long journeys to the East by Fathers Rubruquis and Carpini and Marco Polo and others, must also be included in the Era of Discovery. The growth of trade between the German towns and the Baltic ports which grew in time into the Hanseatic League is one of the vital factors in the development of the ocean-going ship and which was, of course, a later essential in world discovery by western Europe.

From the rise of the Mohammedan power, the Mediterranean Sea divided the Christian world of Europe from

the Moorish power in Asia Minor and along the coast of Africa and, up to the late 15th Century, the southern half of Spain was included in this control. At one time, it looked as though all of Europe must have bowed to the Moor, the Turk or the Pagan. Constantinople and, later, Genoa and Venice strove in vain to hold their positions in this ancient sea. But, as early as the 12th Century, the eastern end of the Mediterranean and the African coast were very largely under the control of the Moorish corsairs; and, by the middle of the 15th Century, as I have said, this control was almost complete. To this condition the constant wars over commercial control of the land routes to the Orient between Venice and Genoa largely contributed. Europe seemed bent upon self destruction.

It is no reflection on the German navigators and shipbuilders of the Hanseatic League to state that the early history of the modern Atlantic ship was largely Portuguese in origin, if Italian in inspiration, and that the scene of this nautical evolution of Europe was along the Atlantic coast of Africa and among the islands of the southern Atlantic, and that much of this history is involved with trade with the Negro peoples of the *Senegal* River and was largely a trade in Negro slaves.

This region was known to the Arabs at an early date as Gilad Ghana, or "The Land of Wealth," and was reached by caravan routes across the desert of Sahara. Gilad Ghana appeared on a map of the Mohammedan geographer, Edrisi, made for Roger the Second, the Norman King of Sicily, in the year 1150. There are vague proofs that Genoese merchants visited the Canary Islands and sailed along the coast of Africa in the 13th and 14th centuries with slave-hunting as perhaps the chief objective.

The Arabic name, "Gilad Ghana," was corrupted into the Italian form of "Geniroes" and was applied to the fierce nomadic Berber-Negro tribes who lived along the Sahara coast of the Atlantic Ocean. It was later changed into "Guinea" and applied to the whole western coast of Africa involved in the slave trade. Later still, it was applied to the northern coast of South America, the present French, Dutch and British Guineas. A gold coin, cast from African gold by the British slave dealers, was known in the 16th Century as a "guinea," a coin worth a shilling more than a pound sterling. By a curious philological indirection, the term has been applied, in the late 19th and early 20th centuries, to the sturdy Italian emigrants who have added so much to the industrial life of the United States. But always, and everywhere, and in all forms, the word "Guinea" (which once meant a Land of Wealth), has been a word of ill-omen.

The beginning of the modern Age of Discovery was the capture of the Moorish city of Ceuta on the African coast, near the Straits of Gibraltar, by the Portuguese in the year 1415. Prince Henry, of Portugal, later to be known as "the navigator," had a part in this successful military operation. Here he saw the evidences of wealth due to trade with regions around the mouth of the *Senegal* River by Moorish Caravan across the Sahara. He knew that this land route was closed to Portugal's enterprise. Portugal was too weak in man power and in wealth for such a venture. But he also seems to have known that the Genoese had once reached this land by an ocean route and here he apparently conceived the idea of Atlantic navigation, the building of a "Greater Portugal" and of development of the slave trade. He had other and more fantastic notions. He proposed a Crusade and planned to

join forces with the mysterious Christian nation of Abyssinia, the Prester John of that age. He believed, as did many others of his time, that the *Senegal* flowed from the sources of the *Nile,* and that it was possible to sail up the *Senegal* and join forces with Christian Abyssinia and attack Mohammedan Egypt on the flank. That he ever seriously considered such a plot is open to doubt.

Ocean trade and ocean navigation were infinitely more ancient in the Red Sea, Persian Gulf, the Indian Ocean and along the eastern coast of Africa, than they were in Europe, or along the Atlantic coast of Africa. There are records of trade journeys to Arabia and eastern Africa by Egyptian merchants at least as early as 3,000 B. C. There was trade in very early times between India, Persia, Arabia, Egypt and eastern Africa. As early as the 6th Century, Cosmas Indicopleutes described the navigation of the earth as confined to four bays, the Red Sea, Persian Gulf, Indian Ocean and China Sea. He also believed the earth to be flat and chided those who differed from him, which proves that there were men in Europe at that time who knew the truth.

The boats of these Eastern waters bear a curious and significant physical relationship to the old *Nile* sailing vessel. The *Nile* has certain peculiarities which lent themselves readily to a specialized type of vessel. The current of the river runs northward, but the prevailing winds blow southward. The Egyptians developed a double-ended boat without a keel, with steering sweep which could be reversed from one end of the boat to the other, and with a single broad sail which could be lowered at convenience and a liberal use of oars or sweeps. Such a boat could either drift with the wind or current or be propelled by the power of oars, or could use its sails when wind per-

mitted. It could easily be drawn up on the sands for purposes of trade or to avoid storms and was as easily launched again. The early boats in the Mediterranean and Red seas, with minor modifications, follow this pattern. Egypt was, apparently, their inspiration. The boats in the Indian Ocean and as far south as Mozambique along the African coast and almost over the entire Pacific Ocean also follow this pattern, but, in some instances, added out-riggers to increase the stability of the vessel in heavy seas. The monsoons in the Indian Ocean and the China Sea blow steadily for several months in one direction and then reverse and blow in the other direction. Navigation and types of boats in these waters were planned on the basis of this peculiarity of the winds. In other words, men, as usual, took advantage of a natural opportunity. The boats were seaworthy, but were rigged to sail on the wind rather than into the wind. In other words, they were monsoon boats. Furthermore, they were sheathed in teakwood to protect them from the boring worms of the tropical waters. Iron was known, of course, in the Orient from very ancient times, but the screw was not known until long after the Christian Era and it was difficult, or almost impossible, to drive iron spikes into teakwood. Hence, the planks of the Oriental boats were sewn together and caulked with palm fiber. When cannon and gunpowder were introduced from the West, such boats made poor platforms for cannon.

As early as the 1st Century of the Christian Era, an account of trade (*The Periplus of Erythraean Sea*), centering in the Red Sea, and connecting Africa, India and Asia Minor in one trade complex, was written in the Greek language. It gives the distances between ports, the character of the people and the rulers and the kinds of

merchandise which might be expected in each of these ports. It is a thoroughly practical, unimaginative and reasonably accurate account of trade as it then existed in the eastern world. There is no doubt that, for thousands of years before western Europe thought about ocean-going trade, ocean trade and navigation were thoroughly established from Mozambique to Ormudz in Arabia, from Arabia to Calcutta, from Calcutta to Java and from Java to China.

As early as the 2nd Century B. C., Chinese explorers had reached the Persian Gulf and knew Arabia as the "Land of the Western Sun, the place from whence all good things come," and confused it with Imperial Rome. The Persians, by no means anxious to lose their position as Middlemen between China and the Mediterranean world, told such harrowing tales of the perils of navigation in the Persian Gulf and the Red Sea that the Chinese feared to make the journey. But, in later accounts, the Chinese showed a knowledge of Arabia and had learned from Arab accounts of the difference between Spain and Portugal and that Portugal was bounded on the west by a vast and impassable ocean. Perhaps we dwell too much on the western journeys to the Far East, such as that of Marco Polo. The fact seems to be that the Far East knew more of the West than the West knew of the Far East.

Again, I must emphasize the fact that all ocean-going vessels east of Africa have many points of similarity to the old *Nile* boats. All of them were developed for monsoon sailing and none were suitable then or now for navigation in the Atlantic. As I hope later to prove, even the Mediterranean boat had to be changed to fit the Atlantic conditions.

It seems scarcely necessary at this late time to state

that in the 15th Century, and long before, learned men of western Europe, more particularly of Italy, knew that the world was a sphere and that the Orient might be reached by sailing either East or West. The map of Pomponius Mela *circa* A. D. 50, as given by Fiske, shows a surprisingly clear idea of the Red or Arabian and Persian seas and the Indian Ocean, a rather blank coast of China, and a truncated Africa; but, nonetheless, an Africa surrounded by water which led directly to the Orient. There is even some basis for a belief that Hamilco, the Carthaginian, had circumnavigated Africa at the instigation of an Egyptian Pharaoh. A comparison of Mela's map with the Catalan map of 1375 proves that this knowledge had survived far into the Age of Discovery. But this knowledge was concerned with the Orient and not with the western or Atlantic coast of Africa.

How deeply Rome was interested in Oriental trade, in the 1st Century of our era may be inferred in part from *Revelation,* C. XVIII, in which the burning of Rome is referred to: "And the Kings of the earth shall bewail her and lament for her when they shall see the smoke of her burning—and the merchants of the earth shall weep and mourn over her; for no man buyeth their merchandise any more: the merchandise of gold and silver and precious stones and of pearls and fine linen and purple and scarlet and all sweet wood and all manner vessels of ivory, and all manner vessels of most precious wood, and of brass and iron and marble and cinnamon and odours and ointment and frankincense and wine and oil and fine flour and wheat and beasts and sheep and chariots and slaves and the souls of men—alas, alas that great city wherein were made rich all that had ships in the sea by

reason of her costliness. For the merchants were the great men of the earth."

Ever since the Greek Hippalus, worthy merchant and navigator, discovered the guarded Arab and Hindu secret of sailing East on one monsoon and West on the other, larger ships had been needed for the Oriental trade. Pliny estimated that coin, amounting to $22,000,000, was required to balance this trade between Rome and the Orient—an over-estimation, perhaps, but still proof of a great luxury trade between the Roman world around the Mediterranean Sea, with Arabia, Africa, India and China. Most of the products mentioned (except, perhaps, the souls of men), were of Oriental, or eastern African origin. Rome sent nothing eastward except silver. Even in those days, there was a close and intimate relationship between Hindus and Arabs—a monopoly of trade and nautical secrets, very difficult for any outsider to break.

All this knowledge seems to be summed up in the letter which Paul, the physicist, or as we know him, Toscanelli, the Florentine, wrote to Columbus in reply to a letter of inquiry written by the Genoese in the year 1474, or eighteen years before the three tiny vessels poked their prophetic prows into the western Atlantic. Toscanelli, as will be noted, did not even take the trouble to write a fresh letter, but sent Columbus a copy of one he had already written to a friend in Portugal on the same subject. Here is the letter as Fiske gives it:

"Paul, the physicist, to Christopher Columbus, greetings: I perceive of your great and noble desire to go to the place where the spices grow. Wherefore, in reply to a letter of yours, I send you a copy of another which I wrote a few days ago to a friend of mine, a gentleman

of the household of the most gracious King of Portugal, before the wars of Castile, in reply to another which by command of His Highness he wrote me concerning that matter: and I send you another sailing chart, similar to the one I sent him, by which your demands will be satisfied. The copy of that letter of mine is as follows:

" 'Paul, the physicist, to Fernando Martinez, Canon at Lisbon, greetings: I was glad to hear of your intimacy and favour with your most noble and illustrious king. I have formerly spoken with you about a shorter route to the places where the spices grow by ocean navigation, than that which you are pursuing by Guinea (western or Atlantic coast of Africa). The most gracious King (of Portugal) now desires from me some statement or rather exhibition to the eye, so that even slightly educated persons can grasp and comprehend the route. Although I am well aware that this can be proved from the spherical shape of the earth, nevertheless, in order to make the point clearer, I have decided to exhibit that route by means of a sailing chart. I, therefore, send to His Majesty a chart made by my own hands, upon which are laid down the coasts and the islands from which you must begin to shape your course steadily westwards and the places at which you are bound to arrive, and how far from the pole or from the equator you ought to keep away and through how much space or through how many miles you are to arrive at places most fertile in all sorts of spices and gems: and do not wonder at my calling "West" the parts where the spices are whereas they are commonly called East, because to persons sailing persistently westward those parts will be found by courses on the underside of the earth. . . .' "

Paul, the courteous, but slightly bored physicist, then

goes on to speak of the great trade in the Chinese port of Zaiton or Canton (from which our word satin is derived) and of the hundred ships laden with pepper every year and also other spices. He also speaks of the learned men of the East, of the Great Khan and the city of Cathay and other matters.

In a second letter, Toscanelli says: "You cannot take in all that it means except by actual experience or without such copious and accurate information as I have had from eminent and learned men who have come from those places to the Roman Court, and from merchants who have traded a long time in those parts."

Eighteen years before the first voyage of Columbus, twenty-three years before the voyage of da Gama, there does not seem to have been any doubts in the minds of learned men as to the possibility of either route to the Orient; but there were grave doubts in the minds of practical men as to whether such a voyage would be profitable.

The same facts which aroused the ambition of Columbus and led to the discovery of the two Americas, must have, somewhat earlier, aroused curiosity in Portugal, if we are to judge by Toscanelli's letters in 1474. This is natural enough. By this time, the Mohammedan pressure on the old routes of trade had become onerous to a degree. The slaving adventures of the Portuguese had by now reached far down the African coast and there they had come in contact with the Arab land traders and with spices of the Oriental trade and within striking distances of the famous Cape. At least Portuguese men of learning were apparently giving the matter consideration. In 1481, Don Juan II sent Diego de Azambujo with 500 soldiers and 100 artisans to establish a fort at LaMina;

in 1484, he took the title of Lord Guinea, and in 1487, Bartholomew Diaz rounded the stormy Cape, later to be known as the Cape of Good Hope.

We must bear in mind that Columbus was schooled in part by Portuguese navigators and was the son-in-law of Perestrelo, one of Prince Henry's captains, and lived for a time on Porto Santo, first of the Madeira Islands to be rediscovered by the Portuguese. Nor must we forget that, in 1487, Pedro de Covilhan and Alfonso de Paiva made a memorable land journey and that deCovilhan actually reached Ceylon, Calicut and Goa. This proves a very definite and practical interest on the part of Portugal in Oriental trade. Of course, none of the wise men of Europe at that time could have known of, or even suspected, the existence of the two vast continents into which Columbus was to blunder while seeking a route to the Indies. Moreover, Toscanelli had made an error of several thousand miles in the circumference of the globe, which added no little to the confusion of the worthy Genoese. But the Portuguese knowledge of the eastern waters, as da Gama's voyage will prove, was incredibly accurate.

Before his death, in 1463, Prince Henry was doing well in the slave trade. Sometimes his ships brought back as many as 1,000 slaves a year. Thus he laid the basis of that brutal trade, in which, somewhat later, England, the Dutch, the French, Spaniards and the Yankees, all took a hand, and which streaked the Atlantic with the dark bodies of those who found their only freedom in the waves. This trade, indirectly, laid the basis of the sugar and cotton planting in the New World, and, ultimately, soaked the fields of the United States with fratricidal blood and raised no mean racial problem both in Latin

America and the United States. The extent of the influence of the slave trade upon the United States may be judged by a comparison with other population figures. There are in the United States about 13,000,000 white, foreign-born citizens; 5,000,000 citizens of Jewish faith, 12,000,000 Negroes, the descendants of African slaves, and about 350,000 Indians, the original inhabitants.

Prince Henry's activities did not pass unnoticed even in his own callous age. It restores faith in human nature to learn that there are always men brave enough to protest. In the year 1441, Prince Henry's ships had returned to the Port of Lagos with a cargo of slaves stripped from the Canary Islands, once called "The Fortunate." These natives were not Negroes; they were a primitive people whose only crime was the possession of weapons vastly inferior to those of the Portuguese. Prince Henry was present, sitting upon his great horse and actively engaged in the selection of his royal fifth of these wretched folk. There was also present the chronicler, Azurara, who wrote as follows:

"Oh thou Heavenly Father!—I implore thee that my tears may not condemn my conscience, for not its laws but our common humanity constrains my humanity to lament piteously the sufferings of these peoples. And if the brute animals with their mere beastial sentiments by a natural instinct recognize the misfortune of their like, what must this, my human nature do, seeing thus before my eyes this wretched company remembering that I, myself, am of the generation of the sons of Adam."

Words, brave in any age, and before any injustice: but, doubly brave in that age and time. Honor to old Azurara for the kind of courage that links man to the angels and gives a meaning and a hope to brotherhood.

He then goes on to describe the parting of families, the beating and wounding of mothers vainly striving to protect and retain their children.

What had royal Henry's slave-trading activities, his clerical monopoly, his ambitions for a Greater Portugal, to do with a water route to India? Nothing at all. Henry was a business man and the slave business was a good business. He was a hunter of black ivory with "Empire building" as a sideline. His proposed crusade was a myth perhaps to save his self respect.

It is not essential to this narrative that we destroy the historic myth which surrounds the name of Henry the Navigator. It is, however, of interest to state that he left minute directions in his will for the disposition of the revenue from the churches he had founded in the Atlantic Islands and along the coast of Africa, and his slave factory, but not the slightest mention of any monopoly of a water route to the Orient around the Cape of Good Hope. By this time, that is, 1463, his navigators had reached only Sierra Leone, where the African coast line turns sharply eastward to form the narrow southern part of this dark continent. It had taken his navigators almost half a century to reach this spot. He cannot be called a great explorer; nor a great scientist; nor a great geographer. He had no idea of improving the trade conditions of western Europe. He was an energetic, practical, mercenary man, engaged in his own peculiar interests. He was the first wholesale slave-trader of modern times.

Indirectly, however, he contributed vastly to the future wealth and power of western Europe. In the 48 years which separate the capture of Ceuta from his death, and in the 33 years which intervene between his

death and the famous voyage of Vasco da Gama, great changes had occurred in Portuguese nautical science due to these innumerable voyages. It had been necessary to develop both ships and instruments able to navigate in the open ocean out of sight of land, in variable winds and strong currents, and along a coast on which there were few and very poor harbors and in which ships had to keep the open sea. No such navigation on a large scale had ever occurred anywhere else on the Western ocean until the Portuguese voyages between the years 1418 and 1497; no such ships had ever sailed any ocean in all the world as the Portuguese energy and Italian skill had evolved during this period for the purposes of the slave-trade along the western coast of Africa. And until these ships and instruments had been perfected, the voyage of da Gama, the voyage of Columbus and the great navigators who followed them would have been physically and technically impossible.

From a political or social point of view, the 15th Century seems neither a fortunate nor even a possible background for so great an adventure as the western European conquests of the world by ocean routes. It was a century in which the gild control within the walled cities broke up in a series of bloody urbane rebellions between workers and master merchants, which covered practically all of central Europe and Italy; of peasant wars which almost destroyed England and France; of bitter struggles between the feudal barons on one side, protecting their ancient privileges, and the rising merchants, and royal or centralized power emphasizing the new order of things. It was also the century of the Black Death or the Bubonic Plague contracted from the parasites in the intestines of Asiatic rats which came to Eu-

rope in the merchant ships from the Levant and which denuded Europe of from one-third to one-half of its population. It was the period of bitter wars between the Catholics and the Protestants, and of the devastating struggles between nations for the expansion of national power. Nor were these the only dangers from which 15th Century Europe suffered.

In 1452, Constantinople fell before the sustained attacks of the nomadic Turks; her ancient walls, which had shielded Europe from the East for centuries, battered down by cannon and gunpowder invented, made and fired by the Christian Franks, hired by Mohamet II. Europe was threatened by the terrible armies of the Prophet, the best soldiers on earth at that time; the Balkans were invaded; nor was this wave of invasion to cease until the 17th Century, when the last Turkish Army was defeated under the shadow of the walls of Vienna.

Aeneas Sylbius, worthy Bishop of Siena, writing in sadness, of these matters to His Holiness, Pope Nicolas V, in this black year (1452), says: "Mohammed is among us: the sabre of the Turk waves over our head: the Black Sea is shut to our ships: the foe possesses Wallachia, whence they will pass to Hungary and Germany. And we live in strife and enmity among ourselves! The Kings of France and England are at war: the Princes of Germany have lept to arms against one another: Spain is seldom at peace: Italy never wins repose from conflicts from alien lordships. How much better to turn our arms against the enemies of our faith! It devolves upon you, Holy Father, to unite the Kings and Princes and urge them to gather together to take counsel for the safety of the Christian world."

But the burden of this adventure did not fall upon a

Europe united by common dangers and alarms. Little Portugal bore the full brunt of the expense and peril and reaped the first rewards. In the 13th Century, Portugal had a population of 3,000,000. By the 15th Century, this had been reduced to 2,000,000. War with the Moors, varied only by wars with Spain, or internal rebellion and constant banditry, had robbed her fields of laborers and packs of famished wolves ranged in winter through the streets of her cities.

There is some devil's justification for Henry's slave-hunting in the need of slaves to till the deserted fields of Portugal. By 1474, as Toscanelli's letter indicates, there was a dawning of interest in a water route to India.

Some importance must also be attached to the land journeys in 1487 of Pedro de Covilhan and Alfonso de Paiva into the East. Paiva died in the city of Cairo, but de Covilhan got as far as Calicut and returned to make a report of his experiences. All of which, with other information, was to be of great value to the shrewd Vasco da Gama. Still, ten years elapsed between the voyage of Diaz and that of da Gama, a decade in which Portugal did nothing about the route to India except, perhaps, secretly to perfect her plans. It must be admitted that she took her time about an event which was to change the whole course of world history.

Portugal did not pay much attention to the first discoveries of Columbus among the Caribbean Islands. Her own explorations had gained the Canaries, the Madeira and the Cape Verde Islands and experience had taught her that islands were not very profitable.

When, however, Columbus skirted a continental body of land assumed to be Asia, Portugal took action. The time had come to stop fooling with the slave trade and

get down to business and make use of her acquired knowledge.

In 1495, Don Manoel, the Fortunate, succeeded to the throne of Portugal, with, no doubt, all proper ceremonies, and endorsed the choice of his predecessor, young da Gama to make the first deliberate attempt to reach the Indies. The choice was a wise one. Back of da Gama lay generations of Portuguese maritime experience in the Atlantic and the man himself was adequate, one of the most adequate men who ever trod the deck of a ship.

There is no doubt that da Gama's voyage must forever remain as one of the most distinguished achievements of men against the seas and clearly demonstrates Portugal's position in nautical matters. At that date Columbus only had to sail thirty-six days on a fair wind, or 2,600 miles from Gomera to the Bahamas and with sound Portuguese pilots to aid him. It is difficult to see how he could have missed the two vast continents which barred his way to Asia and the consummation of his worldly hopes. Da Gama sailed first to the Cape Verde Islands, hauled out, scraped his hull, took in food, wood and water, and then sailed 3,770 miles in ninety-three days against winds and currents to the southern coast of Africa. His course was almost a semi-circle reaching within 200 miles of this then unknown coast of South America.

He left the Cape Verde Islands on August 3rd, sighted land again November 4th or 8th, anchored in the Bay of St. Helena in the land of the Hottentots, where he remained eight days, careening his ships and again taking in wood and water. He rounded the Cape of Good Hope on the 22nd of November, and, on the 25th, anchored in Mossel Bay where he remained thirteen days to rest his crew and repair his vessel. On the 16th of December, he

passed the mouth of the river of "Great Fish" (Diaz's furthest East), and found himself at last in waters never before traversed by European ships. But he did not lack for accurate knowledge of these waters nor of the ports in these strange seas. He was evidently acting on "information received." He was not fumbling around an ocean in the hope of hitting a continent. He knew exactly where he was going.

On Christmas Day, he entered a roadstead to which he gave the logical and pious name of Port Natal. From here, he sailed to the Port of Mozambique. Of this port he had already received word from his spies in the ports of the Red Sea. Here he took on board a Mohammedan pilot who could converse with his Arabic interpreters. This pilot sailed him in safety to the Port of Mombasa, and from the Port of Malindi, he took aboard a Hindu pilot (Banyon) and sailed directly to the Port of Calcutta where he arrived on May 20th just ten months and twelve days after leaving Lisbon.

Calcutta was the chief port of India for spices and cinnamon from the Molucca Islands. This was well known to da Gama. Here, for time out of mind, Arabs and Hindus and expatriated Mediterraneans had carried on a trade with Europe by the Red Sea and the *Nile;* by the Persian Gulf and the *Euphrates* River and by caravans across the Arabian deserts to the ports of the eastern Mediterranean. By either route, there were many tariffs to be paid. If such tariffs could be avoided, Indian spices could be landed in Europe at one-fourth of their former prices. And this was as well known to the aroused traders in these ports as it was to da Gama.

Da Gama gambled for a rich prize, the richest on earth at this time, and with his life as stakes. He clearly aimed

not at a grudged share of Oriental trade but for an almost complete control of this trade.

E. P. Payne, in his lucid and admirable *Age of Discovery,* in the Renaissance Volume of *The Cambridge Modern History,* says: "The arrival of the Portuguese was not altogether unexpected. Their intention of penetrating into the Indian Ocean was well known: And on his arrival da Gama pretended to be in search of some missing vessels of his squadron. Having landed to enquire concerning them, he asked permission to trade, which was granted. Meanwhile the Moslem residents intrigued with the native prince entitled the 'Samori' or 'Zamorin' hoping to deal the Portuguese a crushing blow on the very threshold of their undertaking, representing the new comers as mere marauders, they so far succeeded as to induce the Zamorin to detain da Gama and some of his companions as prisoners. He barely escaped assassination: but a good understanding was at length restored, and the Portuguese Commander after taking in a valuable cargo of pepper, ginger, cinnamon, cloves and nutmeg, besides rubies and other precious stones, sailed on his return voyage on August 29, 1498 and in September, 1499 at length made his triumphal entry into Lisbon. Besides the merchandise which he secured, he brought back precise information concerning the coasts of India as far as Bengal, Ceylon, Malucca, Pegu and Sumatra."

An exceedingly adroit, efficient, fearless man—the right man in the right situation. The Zamorin of Calcutta made a mistake which he lived to regret. A dead da Gama might have granted the maritime East another century of peace.

The second Portuguese expedition which sailed from Lisbon in 1500 under the able command of Pedro Alvarez

Cabral was neither more nor less than a fleet of the war vessels, the most powerful that had ever before floated in the waters of the Orient. Cabral attacked and captured a large Moorish ship on the way into Calcutta and presented it to the Zamorin. The Moors returned the compliment by destroying a Portuguese factory or armed warehouse and massacring the inhabitants. Cabral, nothing daunted, attacked and destroyed ten Moorish vessels and bombarded the town. Jaoa de Nueva, who now arrived from Lisbon with four ships before Cabral's return, learning that the Zamorin was unfriendly, sailed into the harbor of Calcutta and destroyed his fleet. Then stout da Gama returned with twenty ships. It was decided to oust the "Moors" from Calcutta at any price and a mighty war of five months was waged over Cochin, in which Duarte Pacheo defeated the Zamorin.

After this event, an embassy was sent by the desperate "Moors" to the Great Sultan of Egypt asking for cannon and Franks to man them since these terrible weapons were then unknown in India and the Portuguese by the power of this weapon would conquer India. The Sultan wrote to the Pope threatening to destroy the holy places of Jerusalem if the Portuguese persisted in their invasion of India. Nothing happened except an exchange of words.

The rest of the story between 1509–1515 belongs to the great Alfonso de Albuquerque who captured Calcutta in 1510. In June, 1511, he attacked and sacked Malucca, erected a fortress, set up a mint and dedicated a church to the Virgin, and put Portugal in the wholesale spice business. There was a certain admirable directness and efficiency among the men sent out from Portugal at that time. They did their work well and with speed and no

scruples. They knew what they wanted and they also knew the power of their weapons. Empires are not conquered by theorists. By the time of his death, in 1515, Albuquerque had all but cleaned the eastern sea of Moorish vessels. He had even contemplated digging a canal from the *Nile* to the Red Sea and thus starving Egypt, or of marching to Mecca and defiling the tomb of the Prophet. He sent a great treasure to the Pope and also an Indian elephant who bowed thrice before the Papal Throne, to the edification of all men.

Up to 1570, Portugal enjoyed a complete monopoly of trade with the Orient around the Cape of Good Hope. But in this year, Spain conquered her smaller neighbor and began to share with her this trade. Spain had already built up a galleon trade with her American colonies from the Port of Nombre de Dios and at about this time or a few years later had also established a route between Panama and the Philippine Islands. Both the Spanish and Portuguese ships had developed into large cargo carriers, stout, steady, slow and making excellent forts when anchored in strange and hostile harbors. But they were by no means as navigable as Dutch and British ships who had no occasion as yet to sacrifice either speed or fighting qualities to make room for merchandise or for the troups, merchants, and officials constantly passing between the home ports and the colonies. From the time of the elder Hawkins' first slaving voyage between Africa and the Spanish Islands in the Caribbean in 1537, Dutch, French and British slavers, pirateers, buccaneers, all more or less piratical in nature, had swarmed in the seas of the New World. But the Cape of Good Hope route had been respected by all European nations due to the Papal Bull confining it to Portugal, but more particularly

because of their fear of Spanish and Portuguese nautical might.

But long experience in the western ocean had somewhat lessened this fear and the defeat of the Great Armada in 1588 completely shattered it. Holland and England realized that their ships were better sailors and better fighting units than the towering galleons and caracks of Portugal and Spain. In 1587, the year before the Armada, Francis Drake captured the Portuguese carack *St. Philip* and, four years after the Great Armada, in 1592, a fleet of British privateers captured the *Madre de Dios* with a rich Indian cargo and brought the vast ship into the Port of London where its size was greatly admired and most carefully studied by experts. It was about 175 feet overall, 100 on the waterline, and of about 1,000 tons burden. From the wealth of the cargo, the British were inspired to get into the trade in the Orient and their recent naval experiences had convinced them that their fear of Spanish naval power was unfounded.

In modifying their vessels as cargo carriers, Portugal and Spain had lost their warlike power, and ocean trade then, as now, depended upon adequate naval support.

The early history of one of the vital inventions of the Age of Discovery, the Mariner's Compass, is obscured to a degree. Its ultimate form was due to the developments of Mediterranean mathematicians; but it is equally certain that the Chinese were the first people to make use of magnetic iron. There are legendary accounts of "South Pointing Chariots" in which the location of rival armies lost in a fog were determined by the use of the magnetic needle. A somewhat more practical form of this idea was used in surveying the flooded fields along the *Yellow* River for the re-establishment of the boundaries of these

fields. A magnetic needle, thrust through a rice straw, was floated in a bowl of water to determine the north and south direction. The Chinese Junks, sailing to the ports of Java on the Monsoon, are believed to have used such an instrument. The Arab navigators, sailing to China from Ceylon, borrowed this idea in the 9th or 10th Century and transported it to the Mediterranean, where the Sicilians, Italians and Catalonians perfected it. Somewhere between the 11th and 12th centuries, a compass with the needle hung on a pivot, and with the directions marked on a circular chart became a part of western European navigation and spread from the Mediterranean as far north as the ships of Germany and Scandinavia. The Portuguese knew of this invention as early as any other Atlantic navigating nation, and, by the time of da Gama, it had been brought to an amazing degree of perfection.

There remains only to discuss the power carried by the compass-directed ships of the West, which made them irresistible in the East. This, of course, was the combination of gunpowder and cannon. Here our records are clear enough. Saltpeter was a product which came first from China in the 13th Century. It was known as Chinese snow and the rockets made by the Chinese to frighten away evil spirits were called "Chinese Arrows": saltpeter may also have been used as an ingredient in incendiary bombs. No one could have known of gunpowder before the 13th Century because there are no records of saltpeter before this time and saltpeter is an essential to the manufacture of gunpowder. There has been a natural literary confusion between the fire bombs, or the Greek fire, hurled by catapults, and the explosion of gunpowder. There is an account in the 13th Century of a Mongol

Emperor sending to Persia for men to make and operate catapults in order to cast incendiary bombs into a rebellious city. This may have given rise to some confusion. Greek fire was, of course, known in Constantinople from early times, and there is even some basis to believe that it originated in Assyria in pre-Christian times. Until gunpowder became generally known, a literary description of the use of incendiary bombs sounds very much like a description of the explosion of gunpowder.

But there is no doubt that Roger Bacon, that indefatigable investigator of the 13th Century, was the inventor of gunpowder. Having heard of saltpeter, he decided to experiment with it. Some of his experiments very nearly lost to the world one of its greatest and most inquisitive minds. Ultimately, he produced black powder from saltpeter and sulphur and charcoal made from willow trigs. Of his "Devil's Dust," he said: "That one may cause to burst forth from bronze, thunder bolts more formidable than those produced by nature. A small quantity of prepared matter occasions a terrible explosion by a brilliant light. One may multiply this phenomena so far as to destroy a city or an army."

Having produced his miracle, Bacon, with true scientific unconcern, abandoned its developments to others.

In the year 1313, in the Year Book of the City of Ghent, appears this brief note:

"In this year was introduced the use of guns in Germany by a monk."

This terse account of this important invention suggests that there may have been still earlier experiments now lost in the mists of time.

This monk was a Dominican, and, consequently, wore a black robe. This gave rise to the myth of the "Black

Man" or the "Devil" as the inventor of our first cannon. A year later, in 1314, there is a record of a shipment to England of cannon and gunpowder and thus begins the modern international trade in munitions.

The use of cannon must have increased the demand for iron. By the year 1323, a great forge with divisions of labor operation and the use of water power was built in Lorraine. By 1388, iron-working ranked first among the thirty-two major trades of Liége, in Belgium. In Spain and in Italy the iron trades were extremely active.

The use of cannon and of gunpowder spread very rapidly in the turbulent 14th Century. In the archives of Aix la Chapelle, Tournay, Cambray, Rouen, Paris, and other cities, are accounts of the purchase of cannon, or bombards, or bussens; and we have quotations on salt-peter and powder which sometimes reached the astounding price of 30s. a pound, which, if we accept Thorold Roger's estimate, should be multiplied by 12 to yield a modern money equivalent.

The first illustration of a cannon, or at least the earliest so far found, is an illuminated document in Christ College, Oxford, published in the year 1326, which shows a man in armor firing a curiously vase-shaped device with a red hot iron rod applied to the vent hole. The missile of this curious weapon consists of a round ball at the muzzle to which is attached a square-shafted arrow with a great triangular head. The new weapon had not progressed far enough to have evolved its own peculiar missile. The illustration further shows the new weapon as being used to smash a lock on a castle gate.

Bombards were used at the battle of Crecy, 1346. It is believed that Froissart changed some of his earlier manuscripts so as to diminish the importance of the bombards

in this battle because the knights of England and the stout bowmen were displeased with the thought that the credit for their victory over French chivalry lay with these grotesque instruments which were going a long way to destroy the arts of war and the importance of armored men on horseback.

Petrarch (1358), in one of his famous dialogues, replies to a soldier who had mentioned crossbows: "I am surprised that you have not also some of those instruments which discharge balls of metal with most tremendous noise and flashes of fire. These destructive plagues were a few years ago very rare and were viewed with the greatest astonishment and admiration but now have become as common and familiar as any other kind of arms."

An envoy of the Emperor of Constantinople in 1400, seeking aid in Europe against the Turks, mentions gunpowder and cannon as German inventions. There does not seem to be any evidence to disprove the fact that cannon and gunpowder were of western European origin nor that they had been perfected in usage for two or three centuries before the East learned about them through bitter experience.

Japan is the one Far Eastern nation to have escaped the maritime control of western Europe. She has never been conquered, never successfully invaded. From the very first, she adopted western technology. When Adams, the English pilot, was wrecked on her shores, in 1615, he found Portuguese naval cannon mounted on the walls of the Shogun's Palace. Within the last century, more especially the last fifty years, she has borrowed generously from western Europe and the United States. To survive as a people, to maintain her place as a nation,

she had to place her technology on a plain with her rivals and far above her larger neighbors. To criticize this energy in Japan is to criticize the whole force of the distribution of mechanical ideas of invention and discovery of which European civilization is composed. Japan has followed in the technical pattern of the surviving mechanical races. It is to be regretted that, as yet, her social standards are below those of Europe and the United States. This is due, in a large part, to the conservative social environment of Japan, but in no less measure to her lack of physical opportunities within her boundaries. Circumstances force her to look beyond her own boundaries for raw materials and markets. Like England, she needs outside markets and raw materials; like England, she may be forced to fight for them. So long as the world maintains artificial political patterns at variance with economic and technical facts, she has no other choice.

In her struggle for markets and raw materials, she is, by the force of circumstances, compelled to educate vast continental populations in modern mechanical methods, modern warfare and munition manufacture. She is perilously near that area in Asia which for centuries threatened Europe with annihilation and from which Europe was only saved by her technical inventions and efficiency.

In the New World, the land conquests of the 16th and later centuries were complete and unremediable. Whether we look upon the brilliant and pitiless conquests of Spain in Peru, Mexico and elsewhere, or the more leisurely, yet nonetheless equally inexorable movements of the English, French and Dutch in North America against the nomadic tribes of this region, the

answer is always the same: the more primitive technologies have been destroyed by the more advanced technological culture.

This destruction is not entirely due to military pressure, although this plays a large part. The introduction of domestic cattle, the horse, wheeled vehicles, iron and steel, the individual ownership of land, European methods of agriculture, trade, and the use of money, played an equally vital part. The steamboat, locomotive, engines, electricity and automatic machinery, completed this conquest.

The Pilgrim fathers of America were, perhaps, most fortunate in the fact that the native population of the New England coast had recently been decimated by a plague, perhaps small-pox contracted from the Basque fishermen who had long been familiar with the Newfoundland banks. The Pilgrims used the deserted corn fields of the Indians and were taught by the Indians how to cultivate corn and to fertilize the crop with fish taken in the rivers and the bays. The Indians soon learned that the iron hoe enabled them to raise three or four times the crops of corn possible with hoes made from clam shells. Hence, they cheerfully traded surplus corn for iron hoes.

The Pilgrims discovered that the Indians, living along the coast, made wampum beads from clam shells and had established a kind of barter with the Indians living in the interior where there were no clam shells. These beads were at once ornaments, signs of rank and distinction and served as a sort of magical guarantee for all important relationship between the Indian tribes. The Pilgrims interpreted this to mean money in the European sense. With iron hoes and English woolen cloth

they bought wampum from the coastal Indians and accumulated it for purposes of trade. This hoarding was a new idea to the Indians. This hoarding by the Pilgrims raised the price of wampum. The Pilgrims took the wampum a few miles up the river and traded it for beaver skins and other pelts which in turn could be converted into money in England. The Pilgrims could buy corn or beaver skins with wampum and could buy silver and gold money in England with beaver skins bought with wampum and with this money they could purchase iron hoes, hatchets, etc., for the Indian trade. In time, beaver grew scarce or prices fell in the London markets and the Indians suffered from "depression" which they did not understand. Wampum remained small money in the colonies until the growing trade with the Spanish Islands replaced it with silver and until counterfeit machines making wampum destroyed its value. But it remained in use along the Atlantic coast until 1704.

The individual ownership of land, organized trade, money, the plow, iron, the making of roads, the keeping of herds, riding horses and sailing ships had, perhaps, as much to do with the destruction of the Indian as the more obvious and brutal acts of military oppression and the use of fire arms. Their customs, and laws and habits had long matured around a low, Neolithic, mechanical, culture and could not have endured even the peaceful penetration of the advanced mechanical ideas brought by the Pilgrims.

A clearer example may, perhaps, be found in the history of the Eskimo. The Eskimos have never had any formal wars, either among themselves or with the white man. They have lived for centuries along 5,000 miles of Arctic coast depending upon simple inventions which belong

somewhere between the Magdalenian and the Neolithic ages. When the whalers and Russians came among them in the 19th Century, it seemed, at first sight, a blessing. The Eskimos could exchange furs, whale blubber, caribou meat, etc., for iron tools, matches, sugar, rum and tobacco and cloth, with these incredibly generous creatures who came in their great ships each year into the northern bays. They learned to like the white man's food, clothing, tools and weapons. The trade with the whalers changed their technical habits; and, when the whalers departed, or diminished, the Eskimos could no longer obtain their needs from the white man and had almost forgotten their own way of living. Nor could they restore the balance of nature in their essential supplies of wild game, which had been unbalanced by their commercial hunting for the white man. Canada and Alaska had to step in to save these once self-sufficient people from starvation. With all their ingenuity and cultural traditions, they have not been able to escape from the tragic results of mechanical culture contacts beyond their social capacity.

CHAPTER XXIV

WAR OR CIVILIZATION?

NOWHERE in the world have the effects of modern mechanical invention been so brilliantly illustrated as in the United States of America. Japan, within the past fifty years, has made notable advances, but her mechanical progress has been modified by a tenacious social system and by the political necessity of creating an immense war machine, since Japan's markets lie far beyond her area of economic and social control. Russia is still an experiment and a generation is too short a period in which to estimate clearly the social effects of this experiment. Again there are social and traditional environments to limit.

But the mechanical growth of the United States, which has occurred in little more than a century, is one of the most spectacular events in the long history of the diffusion of mechanical ideas. When the first Europeans landed in the 16th Century, the entire New World was, so far as mechanical invention is concerned, in the lower stages of Neolithic techniques. As I have explained, the wheel and domestic draught animals were absent, and, outside of Peru and southern Mexico, even bronze was unknown and no smelted iron occurs anywhere in the pre-historic Americas. For three centuries, the thirteen colonies of England, which were to become the United States, lived precariously on the Atlantic Coast,

their backs to the vast westward continent, their eyes and thoughts on the home land. They supplied England and other parts of Europe with ship supplies, with furs and hides, with such crops as tobacco, and later, rice and dye stuffs, even cocoon silk raised under the bounty system and built up a trade in food stuffs, lumber and small ships with the French, English and Spanish sugar islands in the Caribbean Sea. This trade was in violation of the British (and indeed of all European) navigation laws, since the American shippers did not pay excise duties in the ports of England. As early as the later part of the 17th Century, this omission on their part was causing friction and comment in England and was a contributory factor in the American Revolution of the late 18th Century.

George Washington was one of the few men in power who had any conception of the significance of the great wilderness which lay beyond the Allegheny Mountains and he was most deeply interested in a canal which might bring the valued fur trade from Detroit to the tiny city of Alexandria on the *Potomac* River which in his youth he had surveyed. Mr. Washington had no idea of the mechanical changes occurring in England which were destined to modify social life in the Old World and build a new kind of society in America.

Mt. Vernon, Washington's beautiful home on the *Potomac,* has been preserved as a national shrine within a few miles of the Capital of the United States. It is laid out and was fashioned after the pattern of an English manor farm. Such farms are clearly described in Thorold Roger's *Six Centuries of Work and Wages.* There is nothing in the manner of living nor in the economic philosophy of the "Father of his Country" to indicate

that within a century of his death the nation he had led in rebellion would become mechanically the most efficient and powerful on earth. It was not until after the War of 1812–14, and the dawn of modern industry and tariffs in 1816, that the United States began to move westward and develop the central segment of the North American continent into a mechanical miracle.

There is no question that the machines and powers used in this conquest have been modified to fit the peculiar social and physical conditions, but there is also no question that the basic ideas were of western European origin.

The machines were primarily of European origin with special emphasis on England in the late 18th and early 19th centuries. These brilliant inventions had a powerful influence on Europe, but in Europe they only intensified and strengthened the existing pattern of society. In the United States, they built and moulded and directed a new kind of society. The cities of the eastern coasts, and the Spanish towns along the *Mississippi* and the Pacific, are more than three centuries old. But the great city of Chicago is only one hundred years old and most of the cities of the vast middle west are little more than fifty years—a rise from wilderness to striving economic and industrial life.

In Europe, the modern mechanical structure has been superimposed upon more than a thousand years of culture. There was a great Europe before railroads, steam and electricity, before automatic machines and mechanical inventions in a short lifetime.

This dynamic power in Europe was forced to find a place for itself in a complex of old laws, customs, settled ways of trade and ancient privileges. Modern power

plants and factories rise beside gray old walls of ancient days and modern methods of transportation carry visitors back into ages which touch in memory and in fact the days of Greece and Rome.

Europe is ancient: she is herself the product of contacts with the Mediterranean and Asia Minor. Her new wine presses against the skin of ancient parchments striving to burst forth: she is wrapped in an ancient mantle, precious in memories and difficult to discard in the face of new conditions. She has to conquer the traditions of ages, right the wrongs of centuries, recast her economic and political form and still preserve her precious heritage. These are more difficult conquests than the overcoming of natural obstacles, the conquering of a fruitful wilderness.

There is no greater world problem than the readjustment of political, social and economic Europe to facts of the machines which her genius has created. A composed, tranquil western Europe, free from torturing doubts, free from the intricate complications of archaic laws, would mean a world free from apprehension and able to get about the business of becoming civilized. Confusion in Europe means world confusion. For the moment, she has turned to strange gods and her feet are upon dangerous paths. Be comforted: Europe is a lady of many experiences. She will not fail this test even in these dark hours. She has given light to the world: she will not lack for light to guide her to her greater destiny.

The Age of Discovery, ocean navigation, trade and colonization, and that period in the 18th Century known as the Industrial Revolution are closely related in Europe and the United States in a single social, economic and mechanical pattern. All of these ideas are older in Europe

than they are in the United States. They appeared in Europe in a wealthier, better educated, more compact form of society. The Industrial Revolution belongs to Europe, especially to England. But the physical result of these inventions have been on the surface more manifest in the United States than in any other part of the world. The United States has increased the use of the machine, has developed a greater amount of power, more roads, railways, automobiles, steel, cloth, etc., than Europe.

The United States, once the inventions had taken root, had only to contend with a few hundred thousand individuals living in the Stone Age and with the natural obstacles of a new continent. These natural obstacles were conquered with surprising ease. These European inventions built up the wealthiest and most powerful nation ever known on this earth in a little more than a century.

In Europe, these inventions have increased wealth and multiplied power to an amazing degree but by no means to such a degree as in the United States. In Europe, the inventions had to contend (and they still have to contend) with complicated systems of law, ancient rules and traditions and monoplies, privileges and the political divisions known as nations. The result has been 200 years of political and social confusion, constantly forced into the hideous escape of war. Or, in other words, the last 200 years of technical invention have moved so rapidly in Europe that social adjustments have not yet been possible. And until such social and political adjustments can be effected, the avoidance of war, the preparation of war, the fear of war and the cost of war are terrible burdens.

If the history of man were confined solely to his mechanical achievements, it would form a most distinguished record. Man has made light of the obstacles nature has cast in his way and he has turned these obstacles to his own advantage. Any desire which he has been able to formulate in his intellect, he has been able to create in material form. The thought has been father to many a brilliant deed. Man has permitted no material barriers to restrain these fruitful thoughts of his nor to long retard his actions. Half a million years or more of invention have established his repute as a mechanic.

From a crude cutting-edge of stone to a modern, automatic, power-driven factory, from a bough, dragged along the ground, to wagons, railways, locomotives, aeroplanes and ocean-going palaces; from a simple fire to the complex electrical devices of today, it has been a long journey, as man measures these matters by his invention of time. Every movement has been ahead, a constant progression of invention, growing more specialized, more powerful and more complex, but, always directed towards the conquests of material environment. The power to produce wealth, the power to gain security from nature, the power to overcome material want, have never once lagged in all these endless millennia. There have been, of course, long periods in which this movement, for one reason or another, has been retarded and come almost to a pause; but, if we take the long view of the matter, man, the animal who made tools out of his thoughts, has gone constantly forward to still greater mechanical achievements.

For the past 20,000 years, this progress has been greatly emphasized; for the past 600 years, it has moved at an

amazing pace, and for the past two centuries, its speed has been beyond computation, an utterly confusing phenomenon.

In social and political matters, man has a less flattering record. His invention and understanding in these problems is less active and less fruitful. The world of modern mechanical civilization is armed against itself and the maker of weapons takes social precedence over the maker of tools and the producers of wealth. Yet in the basic philosophies of all great religions, there is proof that man, in his thoughts at least, has recognized both the folly of men and the cure for this folly. Even now, man is intellectually considering the ways of peace rather than of war. The very confusion today of political systems, the great changes made during the last twenty years in the forms of governments, the very conflict of economic ideas prove that man is at least seeking for social adjustments to mechanical facts. And whenever man begins to think, he also begins to solve.

One thing is certain: There was no Golden Age in any historic past. Hope, of necessity, is a problem of tomorrow, not of yesterday.

I am willing to assume that in certain favored primitive societies, such as early Peru, or among the Eskimos before contact with the Russians or the whalers, and in certain of the Polynesian Islands of the Pacific, and perhaps elsewhere, there may have been a greater dignity to labor, a relatively higher social plateau for industry and a more leisurely tempo of life. I am willing to assume that labor in these societies was a less onerous and less deadly burden than in industrial Manchester, or Pittsburgh, Stuttgart, Lille or the Japan of today. Cer-

tainly the products of these primitive industries bear the aesthetic proof of a satisfaction in labor which is so largely absent in industry within historic times.

Physical man has not yet become completely adjusted to the machine tasks man has invented. Modern life has changed many forms of labor into physical and mental degradation through over-specialization and mechanization of processes. Along our brilliant mechanical roads, we have lost a charm and loveliness in the products of labor and an interest and joy in the tasks of labor, which, at our peril, we must recapture. I am also willing to assume, with some qualifications, that in the 12th and 13th centuries, in certain favored industrial areas, behind the protection of walled towns and under Gild social control, certain small groups of artisans obtained, for a brief period, something of the dignity and security of labor evident in primitive society. Here again we see proof of this satisfaction in the products of their industry. The cathedrals of Europe and the decoration of these cathedrals express higher flights of the imagination than anything that we have done since; and they are also sufficient proof that labor in those times was not drudgery. Society, then, worked for society, and not for selfish individualism. It had a plan and purpose comprehensible to man. It was, no doubt, a period of strong discipline but of creative imagination, and many of the ideas which we today call "modern" find their origins in the period when Europe was one in philosophy, almost one in religion, and, one, at least in the language of religion and learning. From many points of view, the 13th Century represents western Europe's greatest social efforts, a balanced relationship between mechanical and social energy and a period in which the social and in-

dustrial energy were devoted to the needs and the aspirations of society rather than to the aggrandizement of nations, classes or individuals.

And yet this period, which endured scarcely two centuries, represents only a series of more or less isolated social and industrial islands in a vast ocean of serfdom, slavery, constant warfare, disease and ignorance. The Gilds not only excluded the ruling classes from control, but also the lower classes from employment. When the city walls were broken down by cannon, and when the Gild customs were shattered by the impact of world commerce and specialized industry in the 14th, 15th, and 16th centuries, Europe was swept with bloody struggles, with want, with misery, and oppression and disease and unemployment, which have scarcely yet come to repose within our own times.

About 20,000 years ago, oats, wheat and other cereals, domesticated animals and wagons gave a price value to land and a significance to social units. These were great inventions, fruitful ideas and in their possession earth rejoiced. But, here, in these very ages, war was invented. Thousands of years before Christ walked in Galilee, men had turned war into the most hideous and most profitless, yet most distinguished, of all occupations. The war record of Babylon and Assyria, of Egypt, Greece and Rome and Persia is a nightmare of cruelty. Have the wars men have fought since the dawn of modern times been any the less brutal or profitless? Where can we draw the line between past and present wars except in the constantly increased efficiency of war weapons?

Here is a factual record of the so called Great War—the soberly considered balance as drawn up by professional soldiers who took part in it:

CASUALTIES OF ALL BELLIGERENTS IN THE WORLD WAR

(Compiled by U. S. War Department)

Allies	*Total Mobilized Forces*	*Killed & Died*	*Wounded Casualties*	*Prisoners & Missing*	*Total Casualties*	*Per Cent*
Russia	12,000,000	1,700,000	4,950,000	2,500,000	9,150,000	76.3
France	8,410,000	1,357,800	4,266,000	537,000	6,160,800	73.3
British Empire	8,904,467	908,371	2,090,212	191,652	3,190,235	35.8
Italy	5,615,000	650,000	947,000	600,000	2,197,000	39.1
United States	4,355,000	126,000	234,300	4,500	350,300	8.0
Japan	800,000	300	907	3	1,210	.2
Roumania	750,000	335,706	120,000	80,000	535,706	71.4
Serbia	707,343	45,000	133,148	152,958	331,106	46.8
Belgium	367,000	13,716	44,686	34,659	93,061	34.9
Greece	230,000	5,000	21,000	1,000	27,000	11.7
Portugal	100,000	7,222	13,751	12,318	33,291	33.3
Montenegro	50,000	3,000	10,000	7,000	20,000	40.0
Total	42,188,810	5,152,115	12,831,004	4,121,090	22,089,709	52.3
Central Powers						
Germany	11,000,000	1,773,700	4,216,058	1,152,800	7,142,558	64.9
Austro-Hungary	7,800,000	1,200,000	3,620,000	2,200,000	7,020,000	90.0
Turkey	2,850,000	325,000	400,000	250,000	975,000	34.2
Bulgaria	1,200,000	87,500	152,390	27,029	266,919	22.2
Total	22,850,000	3,386,200	8,388,448	3,629,829	15,404,477	67.4
Grand Total	65,038,810	8,538,315	21,219,452	7,750,919	37,494,186	57.6

What these figures meant and still mean in human misery, in heartaches, in hopes deferred and defeated, is beyond estimation. An economic evaluation seems almost sacrilegious. Yet this must be true: for four years, these sixty-five million boys consumed and destroyed wealth but could by no means produce wealth. More than half of them have never since produced wealth. The world at large is just so much poorer for this wealth which was not produced as well as for the wealth destroyed. To this already staggering total, we must add the cost of up-building this war machine during the years which followed the war. The cost and the loss of every soldier under arms, every worker in a munition plant, every builder of military planes or vessels of war, no matter how justified from a political or nationalistic point of view, belong on the debit side of

civilization's ledger. The material wealth poured into this latest shambles was the least part of the social cost. This has been true of every war men have fought since the invention of the bow and arrow: it will be equally true of any future war.

It has been estimated that between 1913 and 1914 the world spent about $4,500,000,000 in preparing for the World War. Between 1935 and 1936 the same world, with the multilated still in hospitals and with no debts paid, spent $14,500,000,000 in preparing for a war which no man desires and which all men hate. Is this a measure of the cost of the next war?

Let us look at the problem from another point of view: In the year 1918, in the city of Washington, D. C., where the American constitution is guarded as a treasure and contains the clause, among others, granting freedom to the press, Government agents destroyed the plates and the first edition of Congressman Charles A. Lindbergh's book, *Your Country at War*. It was not a great book, but it was a brave book. It attacked earth's greatest monster, the war mania, then devouring the world. It attacked not the hideous idea of war, but an actual war, a very different thing. Philosophy and drum taps do not mix.

On page 33 of the second edition appears this statement: "Already since the war began in Europe, the finance speculators have exported $6,000,000,000 of value of American products in excess of the products that we Americans got back in exchange, which fact the speculators have used as an excuse to raise the price to American consumers on the 'trust' controlled products approximately $17,000,000,000."

Does this not mean that all the money spent in the United States in that year was worth $17,000,000,000

less, bought that much less, than the same money in the year before? Is this not a legitimate item to be added to the cost of any war? Was this not a tax, an invisible tax? Can we not add similar costs among all the belligerents during the duration of the war and the period of recovery and re-arming for the next war?

Let us turn and compare the social costs of the depression of 1929–33, which were to a large degree an aftermath of the waste and confusion of war. At one time in that depression, unemployment in the United States alone was estimated at 15,000,000. It is reasonable to assume that if each of these workers had been employed, they would have produced a value equivalent to $5.00 per working day. Thus there was a loss to the United States of $13,500,000,000 per year of wealth-producing energy caused by social ineptitude. To this must be added the cost of feeding, clothing and housing and hospitalizating the unemployed. It makes no difference who paid the bills—families, local communities, States or the Federal governments—the loss to society was just as real. And wealth that is not produced because of social maladjustments must be reckoned as social loss. If to this staggering cost we add similar costs in Europe, the total grows beyond the imagination to grasp. The United States, free, for the time being, from the pressure of war, has spent a few grudged billions of more or less synthetic dollars in public works to alleviate the social tragedies of unemployment. Europe has partially met the problem of war-created unemployment by putting a new generation of boys in uniforms and arming them with the most deadly implements to destroy each other. The activities in munition plants have been another way of stimulating industry as well as preparation

for war. Are not these all war costs? Who pays the bills?

The material power of western European mechanical society is clearly demonstrated by the fact that it has spent untold billions of money, wasted immeasurable quantities of materials and energy on meaningless and profitless and tragic destruction, and yet maintains some outer semblance of civilized society. It is a curious paradox that society accepts such staggering costs almost without protest. It is a waste of time, an indirection of thought to blame these conditions upon the munition makers. In war, everything consumed is munitions: wheat and rice, wool and cotton, no less than chemicals and guns. The trade in weapons is, God knows, a grim trade. Yet the gun dealers are the product of society, not society a product of the gun dealers. War cannot be conquered by anything but the greatest power of all, the power of thought. It is a condition of the mind, not a tally of weapons. To outlaw war, it is first essential that the individual minds reflect peace. But if attempts are made to spend some of this synthetic money and employ a small portion of this otherwise waste energy and make the world more beautiful, more agreeable, more secure from want, misery, ignorance and disease, this is called extravagance, waste, etc. The world always has the "money" for murder *en masse,* but never, or almost never, for peace.

Suppose one-half or one-quarter of the true costs of the last war and its aftermath had been spent intelligently in plans to improve the world, clean out pest holes, lead water to deserts, destroy slums and spread education and create beauty spots and give to leisure a fruitful direction. Would the world today be armed against itself? Is there not imagination enough to see that if

peoples of the world make peace, they cannot make war? Is there no other foe on earth for man than man? Have courage and intelligence no other objectives save the killing of brothers?

What is the world's record in social matters affecting the lives of those men and women brought into personal contacts with raw materials, tools, implements, machines and processes? We still refer to this large group as Labor, as if the term held some unworded reproach. How has society treated them since society took to the art of written history?

In an ancient papyrus traced with a reed stylus in a forgotten city along the *Nile,* a scribe advises a youth to study letters, since all other occupations open to him are so disagreeable, so onerous and so lamentably lacking in rewards and consideration. The baker, the laundry worker, the stone-cutter, the weaver, the tailor and the messenger are all pointed to with a supercilious pity. Surely here was no Golden Age for labor.

In the classical age of Greece there was slave production in small factories and division of labor in crafts, and, to a lesser degree, in processes, and also merchandise produced for export or sale and profit rather than for local consumption. In the later centuries of the Roman rule, over half the population of the Empire were either slaves or attached by stern laws to the land or to some mechanical pursuit. The absence of mechanical invention during these centuries is proof sufficient that labor was "cheap." The "Coloni" of the Roman Empire became the serfs of the Dark and the Middle Ages.

Boissonade refers to the last century of the Middle Ages (14th) as a period *par excellence* of urban revolution. He mentions the Red Terror of the sailors and

artisans at Salonica (1342–52). In Italy the plebeians of the small crafts and the proletarians warred with the greater bourgeois and the capitalists and the nobles. There were almost continuous and bloody riots in Rome, Genoa, Bologna and Sienna. The end of these struggles was a series of more or less enlightened dictators, many of whom are now chiefly remembered as patrons of the arts. At Ypres and Bruges 1323–28 the Jacquerie (a name which survived into the French Revolution) under the leadership of Decker and Piet waged war against all men of wealth until the merchants and nobles combined and defeated them in 1328. Under the dictatorship of James van Artevelte, a revolution of petty bourgeois and the working classes set up a government in Ghent and received the support of the King of England. This was followed by an uprising of the weavers, impatient to set up a government of the working classes, and ended in forced loans, massacres and pillage and conflicts between weavers and fullers. This attempt was repeated in 1359 and 1378. Here is scarcely a Golden Age for labor or society at large.

These matters almost led to an international labor rebellion in which it was planned to kill all merchants, masters and nobles. The Battle of Rosenbecque, November, 1382, which cost the lives of 26,000 workers checked this movement in a red mist of hate, suspicion and misery.

In the year 1348, the Bubonic Plague, the Black Death, swept out of Asia, killing half the population of England and Europe. To this terrible visitation the poor who survived looked as to a gracious benefactor, for it had created a greater demand for labor than there was a supply of labor and what was later to be called "natural wages" rose by leaps and bounds. In 1349, the law stepped

in and forbade men to ask, to offer or to receive higher wages than set by the law. This law was, of course, evaded by many. But sheep-grazing was substituted for farming and fewer laborers were needed and the realm was filled with landless, wageless, bitter men. Stricter and stricter grew these laws until those who broke them were cast into prison and fined and all men who refused the statute wages were dealt with as "valiant" beggars, a menace to the very society which had cast them forth. Thus runs the Statute of Labourers intended to weld the fetters forever: "Every man or woman of whatever condition free or bound able in body, and within the age of three score years—and not having of his own whereof he may live, nor land of his own about the tillage of which he may occupy himself, and not serving any other, shall be bound to serve the employer who shall require him to so, and shall take only the wages which were accustomed to be taken in the neighbourhood where he is bound to serve."

This law is dated 1351, or just three years after England had been smitten by the greatest calamity the world had known, which should have bound men together in the bonds of brotherhood. But the Black Death itself was not so cruel as the hearts and the laws of men.

And then appeared that strange, fantastic character forecasting future centuries, and called by the sycophantic Froissart "The Mad Priest of Kent"--none other than stout-hearted John Ball. "Good people, things will never go well in England so long as goods be not in common, so long as there be villains and gentlemen. By what right are they whom we call lords greater folk than we? On what grounds have they deserved it—? They are clothed in velvet and warm in their furs and their er-

mines, while we are clothed in rags. They have wine and spices and fair-bread; and we oat-cake and straw and water to drink. They have leisure and fine houses; we have pain and labor and the rain and the wind in the fields. And yet it is of us and our toil that these men hold their state."

In London, towards the close of the 14th Century, men were to see a strange sight. As a cloud rises from an angry sea, as fire sweeps through dry grass, a hundred thousand grim-lipped men stand gathered about their boyish King, Richard II, demanding freedom for themselves and their lands. The King grants these demands, since no other choice is his. Joy breaks over these haggard faces at the mercy of the King; they depart; and the next day, the King breaks his kingly word and Wat Tyler lies stabbed to death on the grass of Smithfield. This was the end of the thing men called "The Peasant Revolt," a terrible portent, but scarcely a harbinger of a Golden Age.

In the Statute of Apprentices of Elizabeth, thirty-two crafts are enumerated which could only be taught to the sons of freeholders. The mercers, drapers, goldsmiths, ironmongers and clothiers were forbidden to take any person or apprentice whose father or mother did not possess a freehold of 40s. In another article, twenty-one crafts are enumerated that might be taught to apprentices whose parents had no property.

With the exception of those holding property, persons of gentle birth and scholars, every one was forced to choose between being a sailor, some kind of a craftsmen or engaging as an agricultural laborer. All failing to make a decision were to be forced into agriculture at fixed wages and under given conditions. No one could

leave a town or a parish to seek to better his lot, without the permission of the authorities or of two householders.

An attempt was made to adjust wages to local costs of living in each parish by the justices of the peace. Every year, before June 10th, in each locality and each corporate town, the justices were supposed to meet to decide this question. Wages were to be fixed by those who paid rather than those who received them.

Thus runs the law known as "The Statute of Labourers": "And calling to them such discreet and grave persons as they shall think, meet and conferring together respecting the plenty or scarcity of the time, and other circumstances to be considered, duly set the wages of all kinds of manual labour skilled or otherwise with such judgment as lay at their commands." It was also decided that all those with less than a 40s. holding, or less than £10 personally and not retained in the household of any noble, nor tenants on a farm and less than thirty years of age, must accept work in the trade to which they were bred and at the legal rate of wages.

In 1563, a Poor Law was passed supplementing in a measure the sweet, if doubtful, charity of the past. If the Bishop found that his exhortations failed and men of "forward and wilful mind obstinately refused to give to the relief of the poor according to his ability," he might be hauled before the justices and dealt with. The justices had to ascertain the number of impotent poor born in the parish or resident there for three years to make provision for them. The conditions which had created unemployment and want were nation-wide, nay, world-wide; but, it was left to each petty parish to bear the load.

But in spite of all these "gracious" measures towards

the outcasts of an industrial indifference and the land grabs which drove men from farms and farm labor, the human discards from unsuccessful slave hunts and piracies, trudged the roads as "sturdy beggars" committing, as might have been surmised, sundry acts of violence to the property and on persons of the "better people" and the gentry. Green quotes a typical incident: "In Somersetshire, the Magistrate having apprehended 100 sturdy beggars and hanged fifty of them out of hand, regretted that it was necessary to await the next assizes before hanging the rest." Unfortunately, the reason for such unusual leniency is not given.

Sir Josiah Child, merchant and philosopher, retiring to his country estate towards the middle of the 17th Century to avoid the Plague of London, and being a useful citizen, put down on paper certain thoughts of his on various matters concerning interest, the plantations, the wool industry, the relief and employment of the poor. In this document, Sir Josiah sets down certain particulars "agreed by Common Consent." "1—That the poor in England have always been in a most sad and wretched condition, some famished for bread, others starved with cold and nakedness—uncomfortable to themselves and unprofitable to the Kingdom—this is confessed and lamented of all men. 2—That the children of our poor bred up in beggary and laziness do by that means become not only of unhealthy bodies and more than ordinarily subject to loathsome diseases, whereof very many die in their tender age, and, if any of them do arrive to years and strength, they are by their idle habits contracted in their youths, rendered forever after indisposed to labour and serve only to stock the Kingdom with thieves and beggars. 3—That if all our impotent poor were pro-

vided for, and those of both sexes and all ages that can do work of any kind, employed, it would redeem some hundred of thousands of pounds per annun to the public advantage."

He goes on to say, "The radical error I esteem to be leaving to the care of every parish to maintain their own poor only. As for instance, a poor idle person that will not work or that nobody will employ in the country, comes up to London to set up the trade of begging—if at length she hath the misfortune in some parish to meet with a more vigilant beadle, than one of twenty of them are, all he does is but to lead her the length of five or six houses into another parish and then concludes, as his masters, the parishoners do, that he hath done the part of a most diligent officer. But suppose he should yet go further to the end of his line, which is the end of the law; and the perfect execution of his office, that is suppose he should carry this poor wretch to a Justice of the Peace, and he should order the delinquent to be whipt and sent from parish to parish, to the place of her birth or last abode, which not one Justice of Twenty (through pity or other cause) will do; and yet the business of the nation itself wholly undone: for no sooner doth the delinquent arrive at the place assigned, but for shame or idleness she presently deserts it and wanders directly back."

This was some fifty years before the first "machines," a century before Arkwright's factory. Society was preparing a pauper population for the machine; the machine did not create paupers.

In his essay on *The Plantations* (none other, indeed, than the famous thirteen states of 1776, destined to become the mechanical marvel of the 20th Century), in

which he weighs their value to old England, he says: "Virginia and Barbados were first peopled by a sort of loose vagrant people vicious and destitute of means to live at home (being either unfit for labour, or such as could find none to employ themselves about, or had so misbehaved themselves by whoring, thieving or other debauchery, that none would set them to work), which merchants and masters of ships by their agents (or spirits as they were called) gathered up about the streets of London and other places, cloathed and transported to be employed upon the plantations; and, these, I say, were such as had there been no English foreign plantation in the world, could probably never have lived at home to do service to their country, but must have come to be hanged or starved or died untimely of some of those miserable diseases that proceed from want and vice; or else sold themselves to soldiers to be knocked on the head or starved in the garrets of our neighbours."

Fourteen years before we come to the first visible invention of the Industrial Revolution, John Kay's fly shuttle in 1734, England had her first major financial panic. Surely this curious economic phenomenon cannot be attributed to mechanized industry, since no such industry as yet existed. No one at that time could plead technology as an excuse for economic folly.

England by the Treaty of Utrecht had received a witch's gift from reluctant Spain—the monopoly of African slave trade in the Spanish possession in the New World—a sort of recurrence of Henry the Navigator's business in the 15th Century. On this mythical monopoly English financiers built up the famous South Sea Company.

Here are the words of Anderson, a contemporary of

these events. . . . "The year 1720 is memorable in our financial history for the famous South Sea scheme or project adopted by the Government and the legislature of effecting the liquidation of the national debt by the instrumentality of the merchantile company of that name, which had been incorporated in 1711 by act of parliament, for the very different object of carrying on a private trade to the South Seas.

"As soon as the company was placed in its new and extraordinary position, the eagerness to purchase its stock became a universal mania. But, wild as was the epidemic phrensy that seized men's minds on this occasion, and disastrous as it proved in its consequences to the fortunes of numerous individuals, it was probably neither in its beginning symptomatic of anything unsubstantial or tending to a decline in the national wealth, nor in its ultimate consequences very much of a public or general calamity.

"The years 1694 and 1695, for instance, were remarkable project-years. Among more schemes that were then set on foot, and which eventually came to nothing, were the famous Dr. Hugh Chamberlain, the man-mid-wife's, Land Bank, for lending money at a low interest on the security of land, and establishing a national paper currency on that basis: another scheme of the same kind proposed by one John Briscoe; various projects of fishing for lost treasure in the sea; projects for pearl-fishing, for mining, for turning copper into brass, for the manufacture of hollow sword-blades, glass bottles, japanned goods, printed hangings, Venetian metal, etc.

" 'Some of which,' says a writer of the day, who has given full details on the subject, 'were very useful and successful whilst they continued in a few hands, till

they fell into stock-jobbing, now much introduced, when they dwindled to nothing. Others of them were mere whims of little or no service to the world. . . . Moreover, projects as usual begat projects—lottery upon lottery, engine upon engine, etc., multiplied wonderfully. If it happened than any one person got considerably by an happy and useful invention, the consequence generally was that others followed the track in spite of the patent, and published printed proposals, filling the daily newspapers therewith; thus going on to jostle out one another and to abuse the credulity of the people.'

"Of the great legal corporations whose stock was raised for the time to extravagant prices he enumerates, besides the South Sea Company, whose original 100£ shares came at last to sell for 1,000£ each, the East India Company, whose 100£ shares rose to 445£; the Bank of England, whose shares, originally worth about 96£ rose to 260£; and the Royal African Company, whose 23£ shares rose to 200£. Besides these there were, having doubtful charters, the Million Bank, whose stock rose from 100£ to 440£; the York Buildings' Company, whose 10£ shares rose to 305£; the Lustring Company, whose shares originally of 5£ 2s. 6d. rose to 120£ and others."

Speaking of the more doubtful projects, Anderson says: "The utmost that appears to have been paid even on those projects that 'had one or more persons of known credit to midwife them into the alley' was ten shillings per cent. 'Persons of quality of both sexes, were deeply engaged in many of these bubbles, avarice prevailing at this time over all considerations of either dignity or equity; the males coming to taverns and coffee-houses to meet their brokers, and the ladies to the shops of mil-

liners and haberdashers for the same ends. Any impudent impostor, whilst the delusion was at its greatest height, needed only to hire a room at some coffee-house or other house near that alley for a few hours and open a subscription-book for somewhat relative to commerce, manufacture, plantation or of some supposed invention, either newly hatched out of his own brain, or else stolen from some of the many abortive projects of which we have given an account in former reigns, having first advertised it in the newspapers the preceding day, and he might in a few hours find subscribers for one or two millions—in some cases more—of imaginary stock. Yet many of those very subscribers were far from believing those projects feasible; it was enough for their purpose that there would very soon be a premium on the receipts for those subscriptions, when they generally got rid of them in the crowded alley to others more credulous than themselves. And in all events, the projector was sure of the deposit money. The first purchasers of those receipts soon found second purchasers, and so on, at still higher prices, coming from all parts of the town, and even many from the adjacent counties; and so great was the wild confusion in the crowd in Exchange Alley, that the same project or bubble has been known to be sold, at the same instant of time, ten per cent. higher at one end of the alley than at the other end.' "

Anderson says that he well remembers what were called "Globe Permits," which came to be currently sold for sixty guineas and upwards each in the alley, and which were, nevertheless, only square bits of a playing card bearing the impression in wax of the sign of the Globe Tavern in the neighborhood, and the words "Sail

Cloth Permits" for a motto, without any signature, and only conveying to their possessors the permission to subscribe some time afterwards to a new Sail Cloth Company not yet formed.

In what essential does this panic in the first quarter of the 18th Century differ from subsequent economic maladjustments including the most recent one of 1929 *seq.* from which we are still suffering?

MacPherson, in his *History of Commerce,* speaking of the panic in England and the United States in 1787, says: "Britain instead of being ruined for want of commerce with America, as had been predicted,—was in danger of suffering from over-enthusiasm of the merchants for forming new connections in that continent with persons not entitled to a shilling's credit. Many of these adventurers, immediately upon their arrival in America, converted their goods into ready money at any price, and then shipped themselves off for the continent of Europe or hid themselves in the boundless back countries of America under the new assumed character of land robbers."

Coxe, quoted by Craik, says: "In the year 1787 the remains of the excessive importations of the four preceding years were constantly offered for sale at prices lower than their cost in Europe; that considerable quantities of European goods were carried from America during those years to the West Indies and sold even there under European prices."

There were panics in England and the United States in 1816 due to the collapse of business and the end of the Napoleonic wars. As an example of the financial vicissitudes of war may be cited the rise and fall of the price

of cochineal, the dried carcasses of an insect grown on Mexican cactus, which produces a brilliant scarlet. This dye was used for "the thin red line" of British soldiers. Before the Napoleonic wars, the price was 4s. a pound; by the time of the Battle of Waterloo, it had risen in price to 30s. per pound or almost eight times; a few months after Waterloo, it had fallen back again to 4s. If a comparison were made in the rise and fall of commodities due to war demands before, during and after each war, the cost to society would be clearly demonstrated. That a few individuals make "money" in these shifting price structures does not hide the fact that society loses. It is not only the maker of weapons who is a war profiteer: the cost of the weapons is the least of all war costs.

Thomas Tooke, father of modern statistics, but otherwise an able man, speaking of the year 1825, says: "The speculation in goods proceeded with extraordinary activity from the close of 1824 till an advanced period of the spring following. The speculation anticipation of an advance was not confined to articles which present a plausible ground for some rise, however small; it extended itself to articles which were not only not deficient in quantity, but, which were actually in excess. Thus copper of which the stock was actually increased compared with former years advanced 20 to 80%; spices, 100 to 200, without any reason whatever. In short there was hardly any article of merchandise which did not participate in the rise. Between July 1824–July 1825, bowed Ga., cotton, 7½d. to 1s.6½d; East India cotton 5d.1s/10; cochineal 16s. to 24s.; tobacco from 2d. to 9d.; China raw silk, 16s. to 29s.10d.; stocks in the mines of Mexico next attracted attention. Mines in Chile and Brazil and Colombia were bought with enthusiasm: also in life insurance

companies, also in gas companies." And then prices fell with equal rapidity.

The railroad panic of 1848 in England has already been referred to. There is no need to multiply examples of the social cost of financial panics nor of wars. They all follow the same general pattern. Clearly they are not due to machinery or to the increase of wealth, but to the social inability to use and distribute such wealth with reasonable judgment. Between all the panics and wars there has been not only "recovery" but a vast increase of wealth due to the increase of technical invention. Not even wars and panics, which have been so terrible and so wasteful for the past two centuries, have been able to more than momentarily impede the increase of world wealth. Again and again the mechanics have saved society from the politician.

Let us glance at the humane side of the picture since the Industrial Revolution and measure progress by individual rather than economic standards. In 1784, a certain Dr. Percival was engaged with other medical men to look into the nature of an endemic fever in Manchester. The worthy doctor was true to his oath as a physician. "We earnestly recommend a longer recess from labour at noon and an earlier dismission from it in the evening, to all those who work in cotton mills; but we deem this indulgence essential to the present health and future capacity for labour, for those who are under the age of fourteen; for the active recreation of childhood and youth are necessary to the growth, the vigor and the right conformation of the human body. And we cannot excuse ourselves on the present occasion from suggesting to you who are the guardians of the public weal, this further very important consideration, that the rising generation

should not be debarred from all opportunities for instruction at the only season of life in which they can be properly improved."

In 1802 Sir Robert Peel, cotton printer, member of Parliament and founder of the London Police "Bobbies," had a law passed to better the conditions of these Elizabethan apprentices, marooned from human sympathy by the cabinet economic philosophers of that day in the interests of the "law of free contracts," and "supply and demand," as this applied to human labor.

This Act insisted that the cotton mills should be whitewashed twice a year and properly ventilated; apprentices should be properly clothed and fed, should work only 10 or 12 hours a day with no night work save for exceptions in the larger mills: apprentices were to receive proper elementary instruction and religious training. Two inspectors were appointed to cover all textile industry in Gt. Britain. John Brown in his *Memoirs of Robert Blinco,* says: "The atrocious treatment experienced by thousands and tens of thousands of orphan children, poured forth from our charitable institutions and from parish work houses, and the dreadful rapidity with which they were consumed in the various cotton mills, to which they were transported, and the sad spectacle exhibited by most of the survivors, were the real causes, which in 1802 produced Sir Robert Peel's Bill for the relief and protection of infant paupers in cotton mills.—It would be difficult to produce a more striking instance of the utter contempt, in which upstart owners of great establishments treated an act purposely enacted to restrain their unparalleled cruelty and waste of human life."

In 1801, Mr. Justice Grose sentenced a man named Jourvaux to twelve months' hard labor for ill-treating

his apprentices. Thank God for Mr. Justice Grose. He was an unique judicial figure in his age.

By 1808, the wages of hand loom weavers were half of what they had been in 1800 and for this the power loom was blamed.

In the *Commons Journal* of 1812 appears the famous "Bolton Petition." These poor wretches of hand loom weavers had snatched at an ancient law of Elizabeth's, as the last shred of hope in that dark world. This was the ancient law empowering local magistrates to fix wages with reference to local living costs.

Here is the humble petition of brothers in affliction sitting at the gate of the mightiest and the freest nation then on this earth of ours: "The Petitioners are much concerned to learn that a Bill has been brought into the House to repeal so much of the statute #5 Eliz. as empowers and requires the magistrates in their respective jurisdictions to rate and settle the prices to be paid to labourers, handicraft, spinners, weavers, etc., and that the Petitioners have endured almost constant reductions in the prices of their labour for many years, with sometimes a trifling advance, but during the last 30 months, they have continued with very little alteration, so low that the average wages of cotton weavers do not exceed five shillings per week though other trades in general earn from 20s. to 30s. per week; and that the extravagant prices of provisions (the Napoleonic wars had raised the price of foods and the corn laws of the British land owning squires had still further added to living costs) of all kinds renders it impossible for the Petitioners to procure food for themselves and familes and the parishers are so burthened that an adequate supply cannot be had from that quarter:—other tradesmen generally receive

their contracted wages, but cotton weavers when their work is done, know not what they shall receive, as that depends upon the goodness of the employer's heart."

In 1819, hope in Parliament having faded, it was decided to petition for universal manhood suffrage and a meeting place was set for the Commons of the city of Manchester.

The day before this meeting the borough reeves and constables of Manchester and Solford issued a notice to the public earnestly recommending that the "peaceable and well disposed inhabitants of this town," as much as possible, remain in their own houses on the following day and keep their children and servants within doors.

At 11 o'clock in the morning of August 16, 1819, the Rev. W. R. Hay (Justice of the Peace and Minister of Christ) the Rev. M. Ethelstone, J.P., and various other unreverent J.Ps., assembled at a gentleman's house on Mount Street to get a good view of the proceedings.

The Prince Regent's Cheshire Cavalry and Royal Artillery train were also there. As soon as the chairman of the petitioners opened his address, the riot act was read by Rev. Ethelstone and constables and cavalry charged into an unarmed crowd and sabred them as if they had been Frenchmen.

In ten minutes from the commencement of the havoc, the field was an open, almost deserted, space with the exception of the mounds of wounded and dead. Eleven persons were killed, 420 wounded and of this number 113 were women.

For this act of barbarity, the Rev. W. R. Hay received a benefice of 2,000 pounds a year! This is a measure of the attitude of the socially ruling classes of that time to the demands of labor—a Minister of the Gospel of Love

and Peace was paid $10,000 a year for life for the murder of his fellow citizens!

Thomas Carlyle, looking darkly at the social effects of the panic of 1847, when the Industrial Revolution had marked its first century of progress, said in the opening chapter of *Past and Present:* "The condition of England, on which many pamphlets are now in the course of publication and many thoughts unpublished are going on in every reflective head, is justly regarded as one of the most onerous and withal the strangest ever seen in this world. England is full of wealth of multitudinous produce, supply for human want in every kind: yet England is dying of inanition. With unabated bounty the land of England blooms and grows; waving with yellow harvest; thick studded with workshops, industrial implements with fifteen millions of workers, understood to be the strongest, the cunningest and the willingest our earth ever had: these men are here; the work they have done, the fruit they have realized is here, abundant exuberant on every hand of us: and behold some baleful fiat as of enchantment has gone forth saying, 'Touch it not, ye workers, ye master workers, ye master idlers; none of you can touch it, no man of you shall be the better for it; this is enchanted fruit.'—On the poor workers such fiat falls first in its rudest shape; but on the rich master workers, too, it falls. Neither can the rich master idlers, nor any richest or highest man escape, but all are like to be brought low with it, and made 'poor' enough in the money sense or a far fataler one.

"To whom, then, is this wealth of England wealth? Who is it that it blesses: makes happier, wiser, beautifuller, in any way better? Who has got hold of it, to make it fetch and carry for him, like a true servant, not like a

false servant, to do him any real service whatsoever? As yet no one. We have more riches than any nation ever had before: we have less good of them than any nation ever had before.—In the midst of plethoric plenty, the people perish; with gold walls, and full barns, no man feels himself safe or satisfied.

"Midas longed for gold. He got gold so that whatever he touched became gold. And yet, he, with his long ears, was little the better for it."

I have only one more contemporaneous witness to offer to prove that society at large has not been particularly socially judicious in its application of the technical victories of the Industrial Revolution. One of the most unusual men of the 19th Century was the naturalist, Wallace, who shares with Darwin the discovery of the laws of natural selection. Unlike Darwin, who was in comfortable circumstances, Wallace earned his living collecting scientific specimens in the tropical jungles of the world—the valley of the *Amazon* and later and more famously in the Malay archipelago. A trained and accurate observer, he was by no means blind to the actions of the chief of all primates and the most difficult to understand, none other indeed than *Homo Sapiens* himself.

In 1868, he published his *The Malay Archipelago*, a popular version of his diary. This was six years after his return to England from the wild islands of the Indian Ocean. He had first to write twenty-four scientific articles and help to arrange and classify 125,000 specimens of plants, insects, shells and animals before he felt free to turn his attention to lighter matters. He had returned to an England stranger than any savage island he had visited—stranger and more terrifying. In this diary he describes a market scene in Aru Islands in the year, 1857.

"One of the most surprising things connected with Aru was the excessive cheapness of all articles of European or native manufacture. We were 2,000 miles beyond Singapore and Balavia, which are themselves emporiums of the Far East in a place unvisited by, and almost unknown, to European traders: everything reached us through at least two or three hands, often many more: yet English calicoes and American cotton cloth could be bought for 83s. (the price I assume of 23 yards), muskets 15s., common scissors and German knives at three-half pence each, and other cutlery, cotton goods, earthenware in the same proportion. The natives of this out of the way place can, in fact, buy all these things at about the same money price as our workmen at home, but in reality very much cheaper, for the produce of a few hours labour enables the savage to purchase in abundance what are to him luxuries, while to the European they are necessaries of life.

"The barbarian is no happier and no better off for this cheapness. On the contrary, it has a most injurious effect on him. He wants the stimulus of necessity to force him to labour: and if iron were as dear as silver and calico as costly as satin, the effect would be beneficial to him. As it is he has more idle hours, gets a constant supply of tobacco, and can intoxicate himself more frequently and more thoroughly; for our Aru man scorns to get half drunk—a tumbler of arrack is but a slight stimulus and nothing less than a gallon of spirit will make him tipsy to his own satisfaction.

"It is not agreeable to reflect upon this state of things. At least half of the vast multitudes of uncivilized peoples, on whom our gigantic manufacturing system, enormous capital and intense competition force the produce

of our looms and workshops, would be not a whit worse off physically and would certainly be improved morally if all the articles with which we supply them were doubled or tripled their present prices. If at the same time the difference in cost, or a large proportion of it, could find its way into the pockets of the manufacturing workmen, thousands would be raised from want to comfort, from starvation to health, and would be removed from one of the chief incentives to crime. It is difficult for an Englishman to avoid contemplating with pride our gigantic and ever increasing manufactures and commerce, and thinking everything good that renders their progress still more rapid either by lowering the price at which the articles can be produced or by discovering new markets to which they can be sent.

"If, however, the question that is so frequently asked of the votaries of the less popular sciences were put here, *Cui bono,* it would be found more difficult to answer than had been imagined. The advantages, even to the few who reap them, would be seen to be most physical, while the wide spread moral and intellectual evils resulting from unceasing labours, low wages, crowded dwellings, and monotonous occupations, to perhaps as large a number as gain any real advantage, might be held to show a balance of evil so great, as to lead the greatest admirers of our manufacturers and commerce to doubt the advisability of further development. It will be said we cannot stop it; 'capital must be employed: our population must be kept at work: if we hesitate a moment, other nations now hard pressing us will get ahead, and national ruin will follow.' Some of this is true; some fallacious. It is undoubtedly a difficult problem which we have to solve; and I am inclined to think

it is this difficulty that makes men conclude that what seems a necessary and unalterable state of things must be good—that its benefit must be greater than its evils. This was the feeling of the American advocates of slavery: they could not see any easy comfortable way out of it.

"The fact that has led to these remarks is surely a striking one: that in one of the most remote corners of the earth savages can buy clothing cheaper than the people of the country where it is made; that the weaver's child should shiver in the wintry wind, unable to purchase articles attainable by the wild natives of a tropical climate, where clothing is mere ornament and luxury, should make us pause as we regard with unmixed admiration the system which has led to such a result, and cause us to look with suspicion on the further extension of that system. It must be remembered, too, that our commerce is not a purely natural growth. It has been fostered with legislation, forced to an unnatural luxuriance by the protection of our fleets and armies. The wisdom and the justice of this policy have been already doubted: so soon, therefore, as it is seen that the further extension of our manufactures and commerce would be an evil, the remedy is not far to seek."

There is no need to multiply the details of this dreary record. The lag between mechanical and social invention is too self-evident. The protests, which brave men have made in the past, are as true and almost as unheeded today as when they were first made. Such improvements as have occurred in the material condition of all unprivileged or under-privileged areas of society have been largely the result of mechanical rather than social invention. The world today presents a confusing series of

divergent social experiments each attempting to gain special advantage for limited national areas and all more or less confusing wealth in terms of price rather than equations of value.

World wide economic trouble cannot be permanently cured by the application of temporary local measures. In a world in which the power to produce wealth tends to a common level of mechanical efficiency, neither wealth nor prosperity nor the lack of either can be restrained within national limits nor by political forces. If this age means anything, if the accumulated and constantly enlarging physical powers of society at large mean anything but confusion, they must mean a world in which the actual and potential wealth of the world becomes more and more accessible to everyone. To divert this energy into war, to waste it in sordid corrosive idleness, to attempt to control it by artificial political forms, is to invite disaster. Moreover, it is folly thrice confounded; in all the long history of man, he has never once refused to accept the better tool, never once abandoned the more efficient method in favor of one better adjusted to some social pattern.

In spite of a general improvement in material conditions, and in the face of an incredible increase in mechanical power, the conditions in the two most favored nations on earth are a disgrace to political acumen and economic imagination. Within the past decade, both Great Britain and the United States have devoted no little political energy to better general social conditions. Yet in the face of these efforts, the President of the United States, even after "recovery," has solemnly stated that in the richest nation on earth, the nation freest from the fear and pressure of war, with the largest me-

chanical content, with unlimited raw materials, one-third of its population is under-nourished, inadequately clothed and housed and proportionately lacking in educational, health and recreation opportunities. A leading member of the Conservative government in England has made a similar statement regarding half the population of the British Islands. What then must be the conditions in less favored nations in Europe or in under-mechanized and socially backward Asia?

Is there no answer to these enigmas except war or the preparation for war? By what right can authority exist unless these things can be corrected by authority?

The Near East has been a "problem" from the days of Alexander of Macedonia, until the present breach between the Arab and the Jew. At bottom it is the same old problem: the desire for arable acres in what the late Dr. Breasted so aptly called the "fertile crescent."

In a recent article in the *Atlantic*, Arthur P. Chew discussed this problem in the following terms: "Sometimes fertile regions become deserts through the breakdown rather than the non-development of social controls. As is well known, the greater Arabian peninsula Syria, Mesopotamia, or Irah, Armenia and parts of Asia Minor contain multitudinous architectural remains which prove that these regions were once densely peopled. Regions which as late as the Christian Era supported millions are now desolate and barren. Their forests are gone, their once fertile soil buried by sand. It is unquestionable that the middle East must once have been extremely productive; Asia Minor alone boasted more than 250 considerable cities. Large armies in marches and counter-marches subsisted by foraging in areas that today would hardly feed a herd of goats. Most authorities

do not believe that the climate has changed within historic times. For example, Professor D. S. Sanford, of Oxford University, in a letter to the Director of the United States Soil Conservation Service, declares, 'I am convinced that in the Christian Era at any rate there have been exceedingly few real changes of climate, though there have been vitally important local changes. On every hand we see how man has reclaimed vast areas from the desert and let them decay.' And, further, 'Historically the civilizations of the middle East were thriving only yesterday, but they have scarcely left a trace. Antioch was at the height of its glory as late as A. D. 380. Now it is a ghost city occupying only a corner of the original site—.' It was control of the *Euphrates* and *Tigris* that enabled the numerous inhabitants to maintain prosperous and extensive civilization and to hold back the desert. Now the control of vast irrigation work is distinctly not an individual but a collective task. When the late Milton Whitney was Chief of the Bureau of Soils of the United States Department of Agriculture, he studied the Middle East and concluded that agriculture could thrive there again if the ancient water controls were restored. What caused the ancient engineering works to be neglected and destroyed?

"Undoubtedly the cause was not internal but external; not ignorance of the principles of flood control, but wars, invasions and the resulting social paralysis. Not until the powers of government had crumbled did the engineering works, the dams, the reservoirs and the terraces disappear; not until then did the hills lose their forest covering. It is noteworthy that the contending armies before the Christian Era respected the forests and the engineering works though they destroyed growing crops.

Both the Euphrates and the Tigris carry tremendous floodwaters, which, unlike those of the Nile, come irregularly; and any conqueror, wishing to profit permanently from his conquests, had to leave intact the water systems and the forests. Otherwise he could have reaped no crops. Beside the elaborate irrigation systems, Asia Minor, Mesopotamia, Syria and Persia had luxuriant woods, verdant pastures and fertile meadows—. But, after the Christian Era, the old respect for the irrigation and forest disappeared. New conquerors laid the region waste.

"It was the desert Nomads, followed by the Crusaders, who struck the fatal blow. They destroyed both the forests and the water works. Agriculture had flourished in Asia Minor up to that time. But after the fall of Rome, Mahomet's hordes wrought havoc. Despising agriculture, they strove to kill it. Next came the Crusaders who cut down the olive trees for their engines of war and ruthlessly destroyed the forests. After the Crusaders came the Turkish power, distinctly non-farm minded and completed the destruction of agricultural facilities. Rome had built a road into the heart of Asia Minor. Under the Turks it vanished and commerce virtually ceased. Rome had preserved the agriculture of the region though she had other sources of supply. The Crusaders were transients, and the Turks never dreamed of restoring irrigation works. The social motive, and with it the social power to maintain agriculture, vanished; and the sands of the desert swirled in—."

Could there be any more direct challenge to western European mechanical culture than this man-made desert? Great have been our gifts from this region which our wars and ignorance have yielded to the sands of

bitterness. It was the home of the grape and the olive, of flowering plants; it was at least the second home of wheat and barley and many succulent vegetables. From it, both the West and the Far East have received many gracious gifts of art and technology, of philosophy, language and religion. Today, European diplomacy has forced the Jew and the Arab into bitter conflict, like wildcats confined in a narrow bag. Men are conspiring over a few meager acres of arable soil, forcing, once again, that ancient struggle between the planters of seeds and the herders of animals; and war seems the only solution. If war comes, it will cost more and return less than a scientific approach to the problem.

Within the areas of the Near East (Hither Asia), 4,000 years of warfare have placed their terrible mark upon one of the earth's first civilizations—the mothers of modern civilization. With the powers now at the command of modern Europe, these immemorial wastes and follies can be righted. Fertility and plenty can return where desolation and want and hatred now flourish, as evil herbage of the scorching deserts. If man, with only the power of the ox to aid him, lacking even iron, with no machines, could once have tamed the *Tigris* and the *Euphrates* and stored their life-giving waters against the thirsty days, what might not modern engineers do if united in purpose with this same land?

Here is the arena for a noble struggle, here lies a test for courage, here are the lines of battle drawn! But the task lies beyond the power of any single nation. No one political group dares to build up such a prize because other nations would destroy it by war. It is a task for a Europe united. It can only be achieved in peace and by a united purpose.

Paul B. Sears, in his *Deserts on the March,* has much to say about the agricultural skill of the Indian and Chinese farmers. Nothing in Europe or the United States can compare with them. China has under cultivation almost every arable acre in her wide domain. She saves every ounce of organic matter, even human excrement and the black soil of her rivers to make her hard worked fields fertile. Yet famine, floods and plagues yearly decimate her provinces and make even modern warfare merely an incident in her recurrent misery. As Sears points out, "—The importance of seed selection is not properly understood, and inferior varieties of plants are often grown. But the fact remains that the general standard of practice is so far above that in many parts of the world as to admit no comparison. One of the finest achievements of the Chinese farmer has been the conversion of the Red Basin of Szechuan from an incipient bad land supporting less than 145,000 people in 1710 into a flourishing, beautifully terraced agricultural country side of 45,000,000 inhabitants.

"Yet nothing is more mistaken than to think that China is in any real secure self-sustaining state. She is using fertility stored by the work of her great rivers during millions of years past, supplemented by present tribute on an area twice the size of China proper, but with one-sixteenth as many people. In fact her two great rivers, the Yangtze and the Hwang rise in Tibet, with its sparse population of less than three people to a square mile. These streams are fed by seemingly inexhaustible snows and bear mineral matter along with vegetable material afforded by the world's largest mountains and their lush plant cover. Let modern industry penetrate to these sources and exploit them with the zeal that has

been expended upon our own Rocky Mountains and China proper is doomed."

The terrible floods of the *Hwang* or *Yellow* River and the equally, but less familiar, dust storms of this area, and the "loess" from the Gobi Desert, threaten China with a foe more deadly than the armies Japan can send forth from her industrial agony-seeking markets for her mills and factories in order to buy foods for her millions denied adequate land at home.

In the famine of 1770, ten million died in India. In 1865, one-third of the population of Orassa died of famine (the conservative proportion of fatalities of the Black Death in the 14th Century in Europe). India, like China, depends upon Tibet for water, upon the unchanged mountain tops, from melting snow, from untouched forests to hold the waters in check. Once disturb this balance, once give over Tibet to the modern urge for the profits of individual exploitation, cut down the forests for paper pulp, for cellulose, for synthetic fibers, plough up her hillsides, and China and India are open to a foe more terrible than armed invasions. There would come ultimate floods and draughts, dust storms and deluges of destructive waters that would seal the doom of 500,000,000 human beings—more than the population of Europe.

What political power on earth today can avert this danger? Floods and dust storms do not yield to bayonets, tanks, aeroplanes nor poison gases. Famine is an army that can always march and never rests. Europe and Japan wish to destroy the population of Asia—the largest potential market for their products: Has greed no reason, only an appetite!

I am wearily familiar with that bitter logic of the

West that looks upon war, famine and plague in the East as nature's regulators of the East's teeming millions and regard these evidences of man's stupidity as the escape valve of society against the so-called forces of nature, the desire to procreate the human species. These are not acts of God, they are proof of human ignorance. This insistent urge of the species, of any species, to rise above recurrent disaster and survive is most evident in those lands where the subsistance level is low. The birth rate has a relationship to the average of living conditions. It adjusts itself to the conditions of living and those conditions lie largely within the control of man.

What then of Asia? Is it to remain a prize of war held for short seasons by little military groups but, in the end, always yielding to the greater power of want, misery, of soil denuded of fertility destroyed and the patient hearts of men denied hope?

Japan, Russia and China represent three wholly distinct political forms, antagonistic in economic philosophies, constantly on the verge of open and general military conflict. Such a war is only delayed apparently by lack of mechanical preparation. Such a war would involve more than half the earth's population. India could scarcely hope to remain outside such a struggle and India, for obvious reasons, involves Europe.

Yet all of these nations face the same common perils and all of them have the same access to mechanical forces to avert the universal disaster which must follow such a war and which must come, war or no war, unless the broad problems of conservation are solved by the mechanical power now dedicated to war.

By what devil's philosophy can man choose war as

an outlet for his energy rather than the conquest of a threatening physical environment?

Let them save Tibet, protect the life-giving snows of the Himalayas, even as old Peru, with bronze tools, saved the Andean glaciers for fruitfulness; let them harness the rivers and control the floods, as old Sumer did with the *Tigris* and the *Euphrates*. Man must be greater than his physical environment if he is to remain man.

In Africa, the mosquito and the tzetze fly have slain more than many conquerors. There are wide and fertile areas where neither man nor domestic beast can live because of these insect scourges. There are desert areas that need water, pest holes that might be cleansed. These are the arenas for courage and engineering skill, not the slaughter of men inadequately armed or the exploitation of races still technically in the Neolithic Age.

But Europe and Asia are sick with many ancient ills. They are tortured with fear of wars and reprisals, with vengeance denied or unsated, and look rather to measures of military security than to social measures of fruitful living. All things are seen in the red mists of slaughter and fear. Hope is not the guide. Thousands of years of warfare, centuries of doubt and suspicion, have for the time obscured the fact that the world's peril is only a state of mind, only a tangle of wrong thinking.

I fully realize how utterly impractical, how chimerical all such suggestions must appear to the politically, economically orthodox and the diplomatically inclined. For thousands of years man has attempted to establish "balances of power," "military alliances," "trade treaties," "spheres of influences," etc., all the unstable houses of cards built to be blown over by the airs of self interest

No war ever was won: all wars have been lost by everybody. And yet progress has been made by mechanical ideas escaping from political into social areas and man has received benefits from invention in spite of man.

There was a time when man's social interest did not extend beyond the fire group; there was a time when the possession of caves and the needs of herd hunting spread a somewhat broader area of interest and control and then the herds and harvests of man still further extended his sympathies. Man progressed from tribes to city and states, to nations and even to empires or groups of nations enfolding in one political pattern many languages, cultures, races and religions. Egypt, Sumer, China, Assyria, Persia, Greece and Rome in ancient times and Great Britain today are examples of this social tendency to spread social opportunities and mechanical systems over wider and wider areas.

Can we not hope that a time may come when society at large will realize that many problems are only soluble on a world basis; that since inventions are already world-wide in acceptance, that archaic political inventions now retarding social advancement must be modified to fit the facts?

Modern industry and modern banking are passing over national barriers. The problems of world markets for oil and coal, wool and cotton can no longer be settled on nationalistic lines. There have been patient, if timid, efforts to seek world agreements on matters of wages and hours and living standards between industrial nations. All of these gestures for the moment are tentative and constantly rebuffed by political agencies. Yet the idea of world economic and social problems has been

hatched and the flight pinons are at least downy feathers. Who can say how far such ideas may fly or how soon take flight?

There has grown up a group of men and women called, by political sounding boards, "internationalists." This term is, of course, used to express contempt. But the fact remains that there are men and women who are thinking in terms of the world. Every worthy social idea is first treated with scorn, then with fear, but is ultimately accepted. Who knows any future except by comparison with the past?

There was a time when the majority of men believed that the world was flat. Some men still hold to this faith, but they are now in the minority. The majority of men now believe that world problems can be settled by national controls based upon force: a minority have come to question this belief. It takes a little time for any idea to become a conviction and for a conviction to reach the maturity of action. But ideas have a convincing way in the long run.

Nowhere on this earth have the benefits of a mechanized culture fallen in such bounteous plenty as in the United States. Two vast oceans are as yet adequate physical barriers from the fear of invasion if not of war. Neither Asia nor Europe threatens except as a vortex into which the armed forces and treasure of the Republic might be drawn. North and south of it are friendly neighbors, secure in their own rights, in no wise concerned over the size and physical power of the United States. The population is composed of so many different European and Mediterranean peoples as to have a reasonable balance of sympathy in the affairs of Europe, but, no doubt, the bias is towards language and tradition. These

protecting oceans have somewhat the same relationship to security in the United States as the English Channel once had, and, to an extent, still has, for Great Britain. They are a hazard not easily to be overcome by any enemy.

Over my fire-place there hangs an ancient single-barrelled flint-lock fowling piece. It was cast and finished in a little foundry near Tarrytown on the *Hudson,* about thirty miles north of New York City. Upon the flange, connecting the barrel to the stock, is engraved the significant date of 1776, the year in which the citizens of the original thirteen colonies decided to cast off British authority. It is still in a perfect state of preservation as good and true a weapon as it was 160 odd years ago. When a patriot took it down from a rack of antlers and slung over his shoulder a cow's horn filled with black powder made by the formula Roger Bacon invented in the 13th Century, and hung from his belt a bag of leaden balls cast, one by one, in a bullet mould over a domestic fire, he was as well armed as any soldier on earth; and, if his eye were true and his heart stout, as good a soldier as any on earth.

Today, a perfectly armed, loyal and well led army of 20,000 men could hold the great city of New York under complete control if the population were armed only with sporting weapons. Forms of Government, therefore, are determined, potentially at least, upon the size of armed terrestrial forces and their loyalty or lack of loyalty to established government. Changes can only be wrought in Governments by controlling these forces. There is not the slightest present fear of any such calamity in the United States, but if the United States were forced by circumstances to form a vast national army, they would

create, at the same moment, a force which might destroy the political forms and philosophies of this great democracy.

Large armies are one method of controlling industrial unemployment. The manufacture of munitions is one way of temporarily curing industrial inactivity. For the moment, and forever, it is to be hoped such forms of relief may be unnecessary in the United States.

But there must be an escape for the surplus energy, since the more highly mechanized society becomes, the more and more evident becomes the lag in social planning and the more and more frequent the distressing readjustments. The tendency to produce beyond the ability to distribute causes a constant fluctuation in industry and recurrent periods of social maladjustment.

More than 56% of the inhabitants of the United States live in urban areas. There has been an increase of 5% during the last ten years and over 20% in the last 30 years, or in about a generation. A few of the cities along the eastern seaboard boast a 17th Century origin as trading posts, villages or forts. But the great growth of cities in the United States has occurred within the past century and the most intensive era of urban building has taken place within the past 50 years. It is within this period that the United States achieved its vast and unparalleled mechanical growth, when man found himself in possession of the most powerful material forces the world has ever known.

Yet in all American cities, in most American towns and villages, slums have been allowed to grow. Scandinavia and Holland have abolished slums, England, or at least London, is working in this direction, Italy and Germany have made great progress. But serious slum

clearance is only a debated law now before a confused Congress of the richest, newest and freest nation on earth.

New York City would be an almost intolerable place to live in for the average citizen, if it were not for the inspired efforts of Park Commissioner Robert Moses. In spite of politicians, in spite of reactionary interests, in spite of civic indifference, he has created, and is still creating, from idle labor and machines a coherent park system. Without his viaducts, bridges and parkways, the city containing the greatest number of automobiles in the world would be inaccessible to automobiles. He has built playgrounds, swimming tanks, and wading pools for the city dwellers. His public bathing beaches, are world models. Hundreds of thousands of citizens can enjoy the comforts of the ocean and the countryside because of his vision, knowledge and courage. He is the intellectual and spiritual father of this modern city.

Of all the glittering personalities in American public life today, and for all their empty promises and flux of words, this forthright man, lacking in all political gestures, will be longer remembered and held in higher esteem by future generations. Out of his genius and faith have come fruitful things, where there had otherwise been a desert of vapid promises made and broken until men wearied of the matter. He has taught millions of citizens how to live in cities, he has taught thousands the self satisfaction that comes from honest constructive work. He has abolished despair. His task has only begun.

New York City is situated on an island in one of the most perfect harbors on earth, at the end of one of earth's loveliest rivers. Nature has done her best for this

great metropolis. What has man's stupidity done with this heritage? New York City is a rocky island surrounded by an open sewer at the end of an open sewer 150 miles long. The bay and the river, properly cleaned and restocked with salmon and bass and sturgeon would make life healthier, safer, more agreeable and living cheaper for millions of people. The capacity to do these things is ours; the will to accomplish these things can be aroused.

The ancient kings of Sumer and Akkad once controlled the *Tigris* and the *Euphrates*. Their means were trivial compared to ours. The *Mississippi* and the *Missouri* are bleeding away the top soil of part of the United States. Floods, dust storms, soil erosion by wind and water are causing deserts to march like invading armies across the pattern of America's civilization. Everyone knows this. Wise men, outside the control of politics, have warned us; we have seen with our eyes, or in the myriad agencies by which news is scattered the facts have been made evident. And yet people go on making mud pies along the banks of these rivers instead of attacking the problem as a whole and from a nationwide rather than a political or local point of view.

At Verdun, where "they shall not pass," became the slogan of intrenched democracy, the pitiful bones of half a million boys rest in a mausoleum. In the scarred and sacred soil, rest, perhaps, another half million pitiful mementoes of our folly. This was the profit for billions of treasure. The same sum spent upon a coherent plan would create in the valleys of turbulent rivers a solid prosperity and contentment for more than a million men and women and add to the world great and enduring

wealth—and in a reasonable time pay for itself and yield a profit to society.

In the ten states east of the *Mississippi* there are between three and four million American citizens who, because of three centuries of economic and social indifference, because of the Civil War and the decades of exploitation known as the period of Reconstruction, are living perilously near the verge of starvation and almost wholly denied the benefits of modern civilization. In the midst of these economic outcasts have grown up industrial islands where towns have been created with schools and libraries and decent homes, churches and hospitals to foster industry. Strong efforts have been made to create a solid and prosperous and contented industrial society. How can wages, hours and adequate public services be maintained in these towns in the face of a constant pressure of millions of men and women inadequately employed in a meager agriculture?

Unless the land question can be solved in the South, the industrial problem is beyond solution. The land question is only soluble as national control of the flood and drought of the rivers rising in the Rocky Mountains, flowing across the vast plains, dividing the United States and emptying into the Gulf of Mexico. The problem of the nation, the paramount problem is reclamation of the Louisiana Purchase. From tree-planting on the slopes of the Rockies, dams and canals, irrigation ditches across the plains of the Dakotas to levees and reservoirs through the Middle West and South, there must be devised and performed one comprehensive plan. A nation must be greater than its rivers or a nation perishes.

The state of Mississippi now has 77% of cropper or

tenant farmers, but the State of Iowa has 47% and cropper farming, with all its waste and misery and inefficiency, is growing more rapidly in the wheat and corn lands than in the cotton fields; more rapidly among white than among negro farmers.

Because we live in a machine age, we have not lost interest in good craft work. The progress made in handcraft in Europe, particularly the Scandinavian countries, since the World War has been one of the most amazing features of recovery in those amazing democracies. A new beauty has come to life by the only method by which beauty can be created, by the hand and brain of man, guided by tradition and inspired by the present. This miracle has come to pass in the homes of the Vikings. I do not minimize either individual genius nor skill when I write that this movement in the land of the fjord has been sponsored, encouraged and sustained by government.

In the United States, there are large population groups not lacking in craft skill. Many of the Indians have more than a memory of their ancient arts, the southern mountaineers have kept pottery, furnituremaking and weaving alive: there are people on farms to whom an additional income would be welcome. But they need professional instruction and guidance and example. They need schools, museums, local exhibitions and some form of national distribution. The national government alone can supply these necessities. If government can lend money to machine industry, why not to craft industry?

The only way machine industry can get new design is through hand work, through artistic experiment. There never has been any other way: there never will be any other way.

Schools, colleges, universities, research laboratories are constantly teaching the youth of the United States how to make things better or cheaper. But almost nowhere are boys and girls, men and women taught how to make useful things beautiful with their hands. It took half a million years to invent and perfect a hand. This heritage we have cast aside. There are fine memories in early American crafts in English, Dutch, French and Spanish traditions. These should be re-captured and re-created in the spirit of today. A people who cannot create its own art as well as accept the arts of other peoples, lacks imagination and shirks a plain duty. A trained body of craft workers would add great charm to our lives, relieve want and inspire our mechanical industries.

It has been written, but too often forgotten, "Without vision the people die." Can we not vision a world with cities of dignity, interest and convenience, free of slums and adequate to this age? Can we not surround these cities with pleasant, agreeable and accessible areas for recreation and creative leisure? Modern life sets a rapid pace and we need rest and repose as well as an opportunity for work. Why not have reasonable cities?

Is it a part of mechanical culture to have filthy rivers and fetid bays? Can we not restore our raped forests and harness and control our rivers? Is it our heritage to destroy or pollute every gracious gift of nature and die of our own misdirected energy? Does it impair our freedom to maintain the beauty of our heritage to promote health, comfort and contentment with energy and wealth that would otherwise be wasted?

Are dreams impractical? I know the answer that will be given to these questions: "Where is the money coming from?" My reply is, where does money come from,

where has it ever come from to deluge the world in blood and cloud men's minds with hate and misery? What is money? It has been wampum beads, cowrie shells, or great stones drilled with holes, slaves, cattle, pigs, bits of metal or paper promises so often repudiated. Our money for the moment happens to be based on government bonds; not assets, but liabilities. How much will the gold the world now hides in the earth be worth when it again moves in the currents of world commerce? Money can only be saved as it is used to bring energy and skill in contact with raw materials to produce wealth. Money can only be preserved as it aids in the creation of wealth. It is a force, a state of mind, almost as transient as the labor it commands. Where is the money of Dives or Midas, of Julius Caesar or Louis XIV; where is the money debt Europe repudiated since the World War?

The measure of civilization is the measure of the judgment used for the fruitful release of energy. You can't save money any more than you save a summer's day: it was meant to be used, not hoarded.

There are, of course, the laws, the customs and the traditions and these command respect. There are the sacred sayings of the past. Admitted. But all law and tradition once meant changes from some past, meant the death of older laws. They mark man's efforts to give firmness to some desirable present. They are the mileposts on the road of progress. But, once passed, they are no longer measures of progress. For laws to live, for traditions to survive, both laws and traditions must fit the needs of change and must change themselves to fit these needs. Dead laws are the shrouds in which dead nations are wrapped away.

Two thousand years or more before our era, a mighty

King, none other than Hammurabi himself, took to writing laws and carved these laws on enduring diorite, which scholars may still in part decipher for the unlearned. Here are his words, 2,200 B. C.: "I expelled the enemy North and South. I made an end of their raids. I brought health to the land. I made the populace to rest in security. I permitted no one to molest them—. In my bosom, I carried the people of the land of Sumer and Akkad. Under my protection I brought their brethren into security: in my wisdom I restrained them, that the strong might not oppress the weak: and that they should give justice to the orphan and widow in Babylon, the city whose turrets Anu and Bel raised."

All very worthy objects. No man may complain as to the general principles involved. He then concludes: "If that man pay attention to my words, which I have written upon my monument, do not efface my judgment, do not overrule my words and do not alter my statutes; then shall Shamask prolong that man's reign as he has mine who am King of righteousness that he may rule his people in righteousness."

Hammurabi meant well and wrote his laws not without detail, not lacking in faith, and some of these laws have survived through many codes and languages until these times. But, before his death, men were riding on the new invention, the domesticated horse (known to Hammurabi as the "Ass of the Mountains"), and armed with the new (to Hammurabi) inventions of bows and arrows and swords and spears of iron and Hammurabi's empire had new masters and his laws slight regard.

Yet man must have law, even if no other law than the necessity for change to fit new circumstances. In the United States, the latest frontier of mechanical inven-

tion, lies an opportunity for social experiment hampered for the moment by laws grown a little ancient and decrepit. Will America meet this challenge? Will she use her milestones as hitching posts and deny the opportunity to progress in reason as in power?

Law was already ancient when Babylon was young and this venerable carved stone was fresh from the hands of the carvers. It is impossible to conceive of man without laws adjusting him to his companions, his environment, his tools and his conceptions of that invisible universe which touches his intellect through his imagination. He has bowed to Hunger, to Fear, to Fire, Ice, Iron and Steam, and many another device and force he has snatched and fashioned from chaos. In all the universe, in all times, there never has been, there never can exist, such an anomaly as a lawless man. It is a contradiction in terms. For man exists through the power of thought and through thought alone, and thought is Law. As he thinks, he hopes, as he hopes, he cannot be hopeless. In all his long and weary record there is no justification for despair.

Bone of his bone, sinews, muscles, nerves, eyes and brain, man is the physical product of the tools his thoughts have fashioned out of environment and need. Out of his fears have arisen demons, out of his hopes, gods. Out of inert nature have come his myriad ingenuities which lie scattered over time and space upon this terrestrial globe. He is a shadow cast by his own shadows. But from whence has come the light to cast this shadow?

To his mechanical achievements, we have paid some slight and all inadequate attention. In our thoughts we have measured the power of his thinking and seen the products of his thought. And yet there is something more or else man is the paradox of creation, the most useless

experiment, the most grotesque jest of Fate. Out of the narrow window of his soul, man has, from time to time, caught a faint glimpse of that power from which all power comes, the cause of causes, and the First of Causes. His mind is but the mirror that catches this light.

Man has travelled a long, long journey; he has seen and desired many things; but to each need and every barrier his mind has risen triumphant. He has been adequate. The road still beckons: shadows flicker in sunlight and become substance, dreams take form and lead to greater dreams. Man has by no means done with miracles nor miracles with man. This partnership can never be dissolved while man retains the power of thought. Who then shall set a limit to his progress or a boundary to his thoughts?

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